THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
The M.E.A. Convention	1017
The Bermondsey Clause	1018
Electric Locomotives for the New York Central (*illus.*) ...	1020
New Arc Lamp (*illus.*)	1021
The Bonn Meeting of the German Society of Electro-Chemists	1022
Gas Engine Testing	1024
Our Legal Query Column	1024
Parliamentary	1024
Legal	1029
Correspondence	1031
Business Notes	1034
City Notes	1043
Stocks and Shares	1044
Share List of Electrical Companies	1045
Market Quotations	1046
Electric Tramway and Railway Traffic Returns	1046
Institution of Electrical Engineers:—	
The Steam Turbine as Applied to Electrical Engineering (*illus.*) (*concluded*)	1047
The Steam Turbine in Modern Engineering (*illus.*)	1048
The St. Louis Electrical Congress	1050
The Repulsion Motor (*illus.*) (*continued*)	1051
Review	1052
The Electro-Thermic Production of Iron and Steel	1054
Electric Railways in Germany	1055
"Effluvia" from the Combustion of Coal	1055
New Patents Applied For	1056
Published Specifications	1056

THE

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THE M.E.A. CONVENTION.

NEXT week the ninth annual Convention of the Incorporated Municipal Electrical Association will be held at Derby; an attractive programme of papers and visits has been drawn up, and there is every reason to hope that the Convention will be attended with at least the usual successful results. Apart from the engineering features of the Convention, the scenic beauties for which the district is renowned will ensure the attendance of a large number of members, and the municipal authorities of Derby, Nottingham and Sheffield have graciously promised to "welcome" their visitors. The visit to the Neepsend power station of the Sheffield Corporation, which has been equipped with Parsons turbo-alternators by Mr. S. E. Fedden, will naturally be of special interest; the fine installations at Nottingham, which have been carried out by Mr. H. Talbot, and the large plant at Derby, installed by the present chairman, Mr. T. P. Wilmshurst, are also well worthy of inspection.

Turning to the papers to be presented to the Convention, though these are confidential until read at the meeting, we may be allowed to remark that they appear to be above the average level of interest and usefulness. Mr. C. E. C. Shawfield's exhaustive report on the merits of the Lorain surface contact system of tramways in Wolverhampton, of which he is in charge, is full of valuable information of a kind which has been eagerly looked for, but has not hitherto been obtainable. The author, with praiseworthy candour, places on record the detailed working results of the system, and appears to have convinced himself, at any rate, that it is in many respects superior to the trolley system.

Mr. A. J. Cridge, of Sheffield, in a practical and informative paper, deals with the organisation and management of a central station meter department, subjects which necessarily engage the attention of every station engineer.

Mr. S. L. Pearce, of Manchester, contributes a timely treatise on the large and important question of polyphase sub-station equipment and working, very fully illustrated. Mr. H. Faraday Proctor gives details of the fire at the Bristol works, and shows how he proposes to reorganise the switchgear.

Mr. R. S. Downe, of Southport, discusses in detail the possibilities of effecting economies in boiler houses—a subject which never loses interest for the really progressive and enthusiastic engineer; and Councillor H. J. Blakeway, chairman of the Southampton Electricity Committee, brings up the rear with a dissertation on the financial position of municipal electrical undertakings.

On the whole, there is plenty of material for discussion, and the programme is as well stocked from the intellectual point of view as from the æsthetic and material standpoints. We trust that in all respects the Convention will prove a record success.

D

THE BERMONDSEY CLAUSE.

We publish elsewhere in this issue the report of the proceedings before a Committee of the House of Lords, presided over by the Duke of Northumberland, in which a number of Bills for the confirmation of Electric Lighting Orders came under discussion. One of the Bills was promoted by the Corporation of Maidenhead, and was opposed by (*inter alios*) the Maidenhead Gas Co., who petitioned in favour of the insertion in the Order of at least some form of the "Bermondsey" clause. The ground of the opposition was that electric lighting was not a fit subject of municipal enterprise, but that, if local authorities did engage in it, they should be compelled to do so on those sound commercial principles which govern private undertakings.

The general effect of the Bermondsey clause is probably known to most of our readers; it may be well, however, to refer to the manner in which it came to be placed on the Statute book.

In the session of 1902, the Bermondsey Borough Council promoted a provisional order to extend their area of supply so as to embrace the Parish of Rotherhithe, which is within their borough. The South Metropolitan Gas Co. being the owners of large gas works in the Borough of Bermondsey, and, therefore, large ratepayers, opposed the confirming Bill, and contended that, if the powers sought by the Order could be justified, "provision should be made in the Order to ensure the price charged for electricity shall be such as will make the undertaking self-supporting, and that the powers of charging the rates with the deficiency in the income of the Council's undertaking should not be sanctioned." The company, of course, were interested not only as ratepayers, but as persons furnishing a commodity, the supply of which might be injured by competition.

A committee of the House of Lords, with the Earl of Erne as chairman, allowed the confirming Bill to proceed, subject to the insertion of the following clause:—

The undertakers shall once in every year, after the first year's working of the undertaking, cause to be laid before them a statement and balance-sheet of the accounts of the undertaking, drawn up in accordance with the form of accounts prescribed by the Board of Trade for a local authority under the Electric Lighting Acts, 1882 and 1888, and the undertakers shall thereupon fix annually the charges to be made for the supply of energy in the then ensuing year at such rates (not exceeding the maximum rates specified in the principal order), so that as far as is reasonably practicable the revenue for that year shall not be less than the expenditure for that year.

It will be remembered that by Sec. 9 of the Electric Lighting Act, 1882, undertakers must make up their accounts to December 31st in each year. It was with a view to ensuring that local authorities should not only make up their accounts in accordance with this section, but profit from the lesson taught thereby, that the Maidenhead Gas Co. have sought to obtain the insertion of the Bermondsey clause.

It is by no means certain, however, that the Bermondsey clause, taken alone, would have the desired effect, or, at any rate, the full effect which is desired by those through whose efforts it has in certain cases been placed upon the Statute book. In the first place, although the local authority may raise the price charged to consumers, these charges cannot be raised indefinitely, as they may lead to checking the demand for a supply. Secondly, it is always within the power of the local authority, which is responsible for the lighting of the streets, to raise the price of current supplied to public lamps, and so to merely shift the ratepayers' burden to another column in the municipal accounts. To checkmate this device a further clause was inserted in another provisional order for the supply of electricity in a municipality. Thus it was provided in the St. Marylebone Council's Bill, that the charge for public lighting should not exceed the price paid by consumers who have the like hours of supply. If this clause, together with the Bermondsey clause, were inserted in a provisional order, it would be virtually impossible for the municipality to manipulate the statutory account so as to show that, on paper, the supply of electricity was being furnished at a profit. Suppose, for instance, there was a single-power consumer in a district who, owing to the large amount of current consumed by him was supplied at a very low rate, the local authority would not be allowed to charge more for supplying public lamps than they charged to such a consumer, and in this way any attempt on their part to hoodwink the ratepayers would be effectually checked.

As it seems to us the refusal on the part of a local authority to admit the Bermondsey clause is a clear confession that they mistrust their ability to make their electric light undertaking a paying concern; that they burke criticism of their accounts; and that, in order to avoid having to make a confession of weakness, they prefer to charge the cost of failure to the ratepayers as a whole. For our own part, we fail to see why reasons of this kind should induce the Parliamentary Committees to abstain from inserting the Bermondsey clause in provisional orders.

If the Private Bill Committees are always to be hidebound by precedent, it is possible to find other examples of Bills for Municipal Electric Lighting which contain the above clause. In the Stoke Newington and Woolwich Provisional Orders, which were also heard by Lord Erne's Committee, the same clause was inserted, and the orders were confirmed by Parliament.

The Post Office and Telephones.

In the House of Commons on the 16th inst., Lord Stanley, replying to a question from Mr. Lough, said that after careful consideration he had arrived at the conclusion that it would not be in the public interest to exercise the compulsory powers of purchase reserved to the Postmaster-General by clause 17 of the National Telephone Co.'s license. He will, therefore, not give notice to the company under that clause; and he was unable to say at present whether the negotiations now in progress with a view to a voluntary sale will lead to a satisfactory result. Mr. Gibson Bowles asked a further question, in reply to which Lord Stanley said: "There is plenty of work to be done by telephone without the Government actually entering into direct competition with the National Telephone Co. Of course, if the negotiations fail—I cannot say yet whether they will or not—the circumstances will be entirely changed, and then I shall have to consider what action we shall take as regards competition."

The statement that it was not intended to give notice for compulsory purchase is only what might have been expected from the Postmaster-General's previous remarks regarding the inadvisability of arbitration, but the announcement has been made somewhat earlier in the month

than seems altogether necessary. In the course of negotiations of this sort, it is almost inevitable that at some period a stand must be taken, and either side give some consideration to what must happen if the terms are not mutually acceptable. We are, therefore, not disposed to attach undue importance to Lord Stanley's remarks, and think it would be wise to await further developments. The interests of the State, the Post Office, and the shareholders of the Telephone Co. are alike in rendering it desirable that a solution should be arrived at now. A failure to arrive at a satisfactory arrangement would indicate an unfair or unreasonable attitude on the one side or the other. We need only say that the interests of the State are such as to preclude the Post Office from being unfair; the interests of the Company are such as to render it unwise for them to be unreasonable; and the interest of the telephone users will not permit that there should be another seven years of uncertainty.

Cable Codes.

In our issue of March 11th, 1904, under the heading of "Revolution in Cable Codes," we referred to the system for coding telegrams as inaugurated by Mr. Baronio, known as "Pantelegraphy." We have recently been favoured with a letter from the Pantelegraphy Publishing Co., covering copies of recent testimonials from some of the clients whom the company have been successful in persuading to adopt their system, and requesting us to adopt it also. The testimonials quite bear out what was said in our issue above referred to, for out of examples sent, three refer to mutilation, which, however, it was possible to trace; one states that "on the whole the system had proved satisfactory," while the fifth states the manufactured words to be satisfactory. In view of the 10-letter pronounceable words which may be used on the 1st prox, we think it probable that compilers of special systems will have rather an up-hill task in persuading the public to adopt them. Codes generally contain a key to, or examples of, pardonable errors, which merchants, using their own cipher arrangement, can as easily detect as in Mr. Baronio's system, and this, by the way, only guards against such. The merits of one system over the other will therefore be pretty evenly balanced, as none can provide against careless error, which is the chief evil to contend with. At any rate, it would be better to have a system where even pardonable errors could be to the greatest extent eliminated, and in this direction we are inclined towards the Nicolson system referred to on another page of this issue. None of the testimonials refer to the saving effected in charges, but merely refer to the words and errors; but still we think any system producing a saving of 75 per cent. and upwards in telegraph charges should commend itself to the public. We had occasion some time ago to refer to Messrs. Moreing & McCutcheon's code, in which the attempt has been made to provide, as far as possible, for the needs of any business or social requirements, and we should think that if a series of small cheap and full codes were compiled, adapted to particular trades or enterprises, a really long-felt want would be supplied.

The Workmen's Compensation Act.

Some time ago we had occasion to comment on a case in which an applicant under the Workmen's Compensation Act, was held entitled to compensation in respect of an illness which he sustained, owing, as was alleged, to infection during the course of his employment. In another case where a question was raised as to the amount of damages payable, it was urged by the employers in mitigation that owing to a disease from which the applicant was suffering at the time, the accident could not be said to have caused all the disablement, and that the amount payable should be reduced. In this case, too, the point was decided in favour of the workman. A recent case from a county court in the Midlands shows that the Court may still further penalise the employers where injury is sustained by a workman who enjoys indifferent health. The claim was made by a signalman whose leg was broken by an accident in the course of his employment. As he was wholly disabled for several months, the railway company paid him compensation. They then applied for a review of their award, on the ground that the incapacity caused by the accident had ceased. It transpired that an attack of *locomotor ataxia* had deprived the signalman of the use of his legs. The railway company contended that they were not responsible for disablement from that cause, and medical evidence was called to show that prior to the time of the accident this applicant had been suffering from this disease. Other medical witnesses, however, gave evidence on the part of the applicant to the effect that, although he was suffering from *locomotor ataxia*, the progress of this complaint had been accelerated by the broken leg. The County Court judge upon this found that the employers were responsible for the total incapacity, and made an award upon that basis. While no one can refrain from a feeling of sympathy with the applicant in such a case, it seems a little hard that the employers should be saddled with a liability for all time for the consequences of a disease, for which it was not even suggested that they were in any way responsible. The hardship lies in the fact that if there had been no accident the disease must have rendered the applicant incapable sooner or later. To avoid liability of this kind in the future, employers must take care that their workmen are free from any taint of disease.

An Undignified Withdrawal.

The Board of Trade recently granted a provisional order to the County of Durham Electrical Power Distribution Co., Ltd, with the consent of the local authority, for the supply of the area of the Sunderland Rural District Council, which adjoins the County Borough of Sunderland. No opposition had been heard of up to that stage, but as the time approached for the passing of the Confirmatory Bill, the Sunderland Corporation seems to have been attacked by some insidious form of municipal neurosis, for it suddenly determined to present a petition against the confirmation of the order. The burden of the petition was that at some future indefinite date, the rural district might perhaps be incorporated with the town, and that it would then be somewhat of a nuisance to find a company there supplying electricity. The company prepared for a fight in the committee room; counsel were briefed; witnesses summoned; everything was ready to meet the case of the Corporation. Yet on the appointed day, lo! there was no sign whatever of the opposers. At the last moment they had shrunk from making the proposition to a Parliamentary Committee, that a rural district adjoining a borough must not have electric light and power until the borough has in its own good time extended its boundaries to embrace the neighbouring area. But nothing in the case was more unbecoming than the Corporation's method in retiring (which is referred to in our Parliamentary reports to-day); for no notice whatever was given to the company, whose preparations were therefore all wasted. It was most natural, therefore, that the Committee should so readily accede to the company's reasonable request that the Corporation should be ordered to pay the costs imposed upon the promoters by its eccentric behaviour.

Our Electricity Works Tables.

With this issue, Part II. of our annual statistical tables is presented to our readers. The remarks already made with reference to Part I. apply equally to the present issue. We welcome corrections from users of the tables, and we thank those who have so largely contributed to their compilation.

ELECTRIC LOCOMOTIVES FOR THE NEW YORK CENTRAL.

OUR American contemporaries have been publishing descriptions of the new electric locomotives which are being built for the New York Central and Hudson River Railroad Co. by the General Electric Co., of Schenectady, and the American Locomotive Co. In their electrical features, it is stated, these locomotives differ radically from any electric locomotive hitherto constructed.

The design was submitted in accordance with specifications prepared by the Electric Traction Commission appointed by the railroad company; the conditions which must be fulfilled

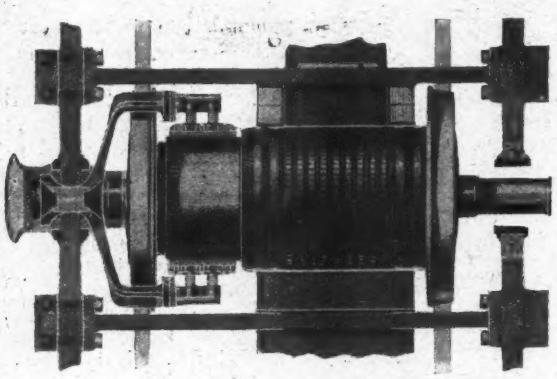


FIG. 1.

were, briefly, that the successful bidder should furnish an electric locomotive capable of making two regular successive trips of one hour each (34 miles) between Grand Central station and Croton, with a total train weight of 550 tons, a single stop in each direction, and a lay-over not to exceed 20 minutes. In addition to this it was provided that a similar schedule should be maintained with somewhat lighter trains making more frequent stops. Finally, it was provided that with a total train weight of 435 tons, the electric locomotive should be able to run from Grand Central station to Croton without stop in 44 minutes, and, with one hour lay-over, be able to keep up this service continuously.

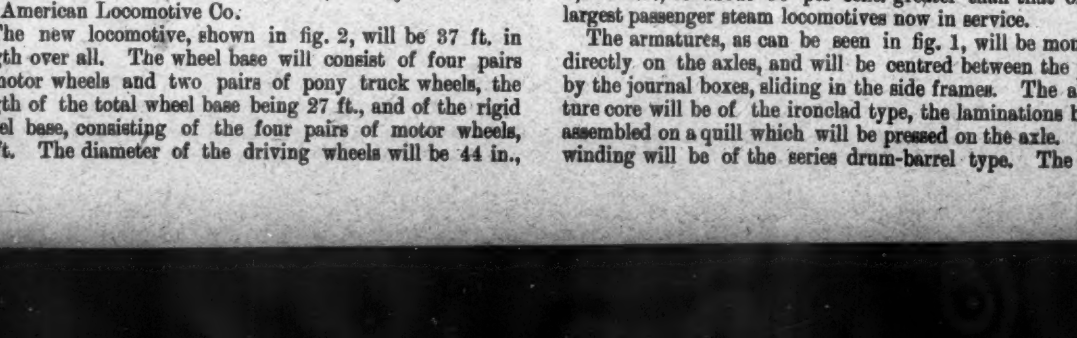


FIG. 2.

No restriction was placed on bidders as to whether direct or alternating current was to be used. The successful bidders were the General Electric Co., in conjunction with the American Locomotive Co.

The new locomotive, shown in fig. 2, will be 37 ft. in length over all. The wheel base will consist of four pairs of motor wheels and two pairs of pony truck wheels, the length of the total wheel base being 27 ft., and of the rigid wheel base, consisting of the four pairs of motor wheels, 13 ft. The diameter of the driving wheels will be 44 in., and of the truck wheels 36 in. The driving axles will be 8½ in. in diameter. The locomotive will be what is known as a "double-ender," and will weigh approximately 190,000 lbs.

The frame will be of cast-steel, and the journal boxes and axles will be designed to permit sufficient lateral play to enable the locomotive to pass easily round curves of 230-ft. radius. The superstructure of the locomotive is to be so

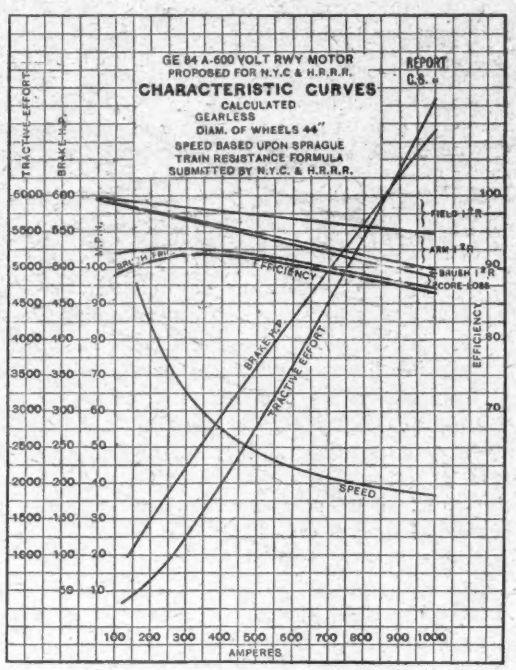


FIG. 3.

designed as to offer the least practicable wind resistance; it is to be of sheet-steel with angle-iron framing, and will be fireproof.

The driving power of the locomotive is to be furnished by four 600-volt direct-current bipolar gearless motors, each of 550 H.P. This will make the normal rating of the locomotive 2,200 H.P., with a maximum rating of about 2,800 H.P., or about 50 per cent. greater than that of the largest passenger steam locomotives now in service.

The armatures, as can be seen in fig. 1, will be mounted directly on the axles, and will be centred between the poles by the journal boxes, sliding in the side frames. The armature core will be of the ironclad type, the laminations being assembled on a quill which will be pressed on the axle. The winding will be of the series drum-barrel type. The con-

ductors will be designed so as to avoid eddy currents and will be soldered directly into the commutator segments. The brush holders will be mounted on insulated supports attached to the spring saddle over the journal, maintaining a fixed position of the brush holder in relation to the commutator.

Unlike the ordinary four-pole motor where the magnetic circuit is made through a separate box casting, the magnetic circuits in this type of electric locomotive are completed through the side and end frames. The pole-pieces are cast in the end frames, and there are also double pole-pieces between the armatures, carried by bars which act as part of the magnetic circuit.

The pole-pieces will be shaped so that as the poles move up and down with the riding of the frame on the springs, they will always clear the armature, and the armature will not strike the pole-pieces even if the springs are broken. The field coils will be wound on metal spools bolted to the pole-pieces, and will consist of flat copper ribbon.

The Sprague-General Electric multiple unit control is to be used on this type of locomotive. The control system will permit two or three locomotives to be coupled together in any order in which they happen to come, and to be operated as one unit by the engineer in the leading cab.

The control system will also be semi-automatic in its action, as it will provide a check on the rate of acceleration of the train, which the engineer cannot exceed, while he may accelerate at any slower rate if he so desires. The control system is designed for a minimum of 300 volts and a maximum of 750 volts.

The weight which will rest upon each of the driving wheels of the electric locomotive will be about 17,000 lbs. Proper distribution and division of the weight among the axles will be accomplished by swinging the main frames from a system of elliptical springs and levers of forged steel, the whole being so arranged as to equalise the load and furnish three points of support.

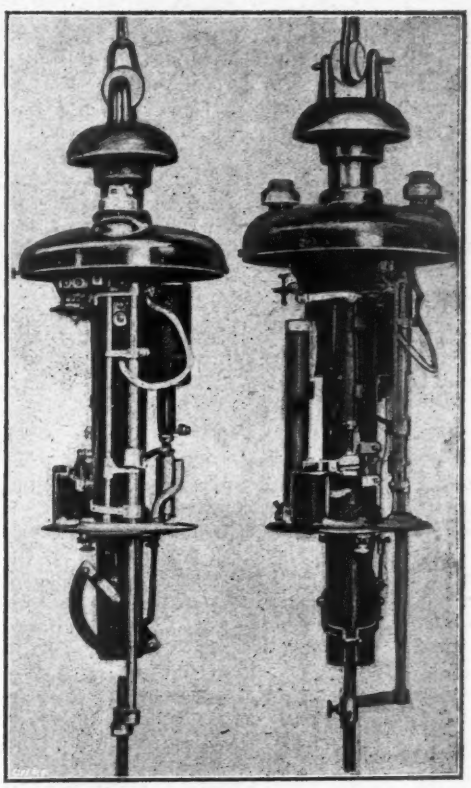
The locomotive will be provided with all the usual accessories of a steam locomotive, including an electric air compressor to furnish the air for the brakes.

In actual performance this locomotive is expected to give better results than any engine hitherto placed upon rails. Fig. 3 shows the characteristics calculated for the motors. With a light train, the locomotive is expected to give speeds up to 75 miles an hour, and with heavier trains, similar speeds can be attained by coupling two locomotives together, and working them as a single unit. Its tractive force will be greater than that of any passenger locomotive now in existence, and it is believed that, in the simplicity and accessibility of its parts, and in the provision made in its design to ensure continuous operation with the minimum chances of failure, it marks an entirely new type of electric locomotive.

NEW ARC LAMP.

An article by Mr. C. P. Steinmetz in a recent issue of the *Electrical World and Engineer* gives an interesting account of a novel type of arc lamp developed by the General Electric Co., Schenectady. In this lamp the black oxide of iron called magnetite is used for the negative electrode, and copper for the positive. Mr. Steinmetz, in this connection, puts forward the view that "the material which carries the arc flame issues from the negative terminal as a high velocity blast, which, when striking the positive, produces heat." Another statement is that the positive electrode does not feed the arc, and "has no direct influence on the phenomena in the arc, but the spectrum of the arc is that of the negative terminal." This is in contradiction to another passage, which says that the efficiency of the carbon arc is due to the extremely high temperature, and, therefore, great brilliancy, of the incandescent crater. The object of making the positive electrode of copper is to enable it to quickly carry away heat, so that it does not get too hot, but yet is hot enough to prevent the deposition of material from the negative upon it, while it is not consumed. Metals of the iron group, as negative electrodes, give a white light, but are combustible in air; their oxides, therefore, must be used, and of these magnetite is the most suitable. Pure magnetite alone is not quite satisfactory, so small quantities of other substances are added, of which titanium is the only one named, to increase the steadiness and efficiency of the arc. The best result has been attained with an electrode composed of impalpable powder compressed into a thin iron tube. Such an electrode, 8 in. long, has a life of 150 to 200 hours. A life of 500 or 600 hours can be attained at the cost of a slight loss of efficiency, but so long a life is not considered necessary.

The light comes from the arc itself, not from the electrodes, and an arc $\frac{3}{4}$ to $1\frac{1}{8}$ in. long is therefore the most efficient; this length is maintained constant by the mechanism of the lamp, which separates the electrodes to a definite distance and locks them there for some hours, until, in fact, by the consumption of the negative electrode, the voltage is increased sufficiently to again operate the feed



Magnetite Arc Lamp.

and reset the arc. The mechanism is said to be much simpler than in the ordinary type of arc lamp, though this is not by any means what one would gather from the illustrations, which we reproduce herewith. No direct statement as to the efficiency of the new arc is given, but we may infer from the remark that the efficiency of pure magnetite is "not very high, hardly twice as high as that of the ordinary carbon arc," that something phenomenal is to be looked for. However, in a paper on the magnetite arc lamp, read by Mr. W. A. Holmes before the Convention of the National Electric Light Association, and abstracted in the *Electrical World and Engineer* of May 28th, it is stated that "the 320-watt magnetite arc lamp gives slightly more light than a 340-watt open arc, or a 460-watt series direct enclosed or alternating enclosed arc. It is claimed that the main advantage of the lamp is the uniformity of light distribution from it." The magnetite sticks cost about 5 cents apiece. It is necessary to provide for upward ventilation to carry off the products of combustion, which would otherwise coat the globe with red oxide of iron. As the light is thrown out horizontally, the lamp is, it is claimed, more suitable for street lighting than the enclosed arc lamp; but this is, to our mind, a debateable point.

Telegraph Rates.—The Eastern Telegraph Co., Ltd., announces a number of reductions in rates for telegrams, "*vid* Eastern," which come into force on and after 1st prox.

E

THE BONN MEETING OF THE GERMAN SOCIETY OF ELECTRO-CHEMISTS.

By JOHN B. C. KERSHAW, F.I.C.

The eleventh annual meeting of this society, now known as the Bunsen Gesellschaft, was held at Bonn from May 12th to 14th, and attracted an unusually large number of members and their friends. The German Universities were represented by Profs. Van't Hoff, of Berlin; Ostwald, of Leipzig; Anschutz, of Bonn; and Nernst, of Göttingen; while two foreign professors, namely, Roozeboom, of Amsterdam, and Arrhenius, of Stockholm, attended the meeting by special invitation, and contributed papers upon important subjects. The scientific and business meetings of the gathering were held in the lecture theatre of the Chemical Institute of the University of Bonn, which has been considerably enlarged since the writer attended there as a student 10 years ago. Friday and Saturday were devoted to the real work of the meeting, and in four sessions of 3½ hours each, no fewer than 18 papers were read and discussed. The discussions, however, suffered somewhat from the absence of any time limit, either for readers of the papers, or for the speakers in the discussions; and as is usually the case at such meetings unless very carefully organised and controlled, the papers which occupied the most time were not those entitled to such a privilege. In the writer's opinion, the German Bunsen Gesellschaft might with advantage follow the example of the English Faraday Society, at its future annual gatherings, and adopt the plan of papers printed and circulated in advance, and read only in abstract form as introduction to the discussions.

The papers and discussions which attracted most attention at Bonn, were those on the "New Application of the Phase Rule," and upon the "Chemical Mass Action of Toxines and Anti-Toxines." Prof. Roozeboom opened the discussion upon the first-named subject, and Prof. Arrhenius upon the second. The two papers upon industrial electro-chemistry and electro-metallurgy, did not arouse much interest, a fact which shows that the German electro-chemist is still more attracted by the theoretical than by the practical side of this new branch of science. It would, therefore, be beneficial to both the English and German Societies if joint meetings could be arranged, say, biennially, in order to correct the tendency to one-sided development, which may be observed in each case; and I trust that the Council of the Faraday Society will give this suggestion due consideration.

The first paper of the Friday morning session was by Prof. Roozeboom, of Amsterdam, and dealt with the "Application of the Phase-rule to the Cooling of Molten Mixtures of Carbon and Iron." The author, in conjunction with other workers and investigators in this field of research, has been studying the subject since 1896, and has obtained results which he considers of great value to practical metallurgists. A diagram giving curves for the separation of graphite, martensite, and the other definite compounds of carbon and iron, which separate on cooling, molten iron containing carbon in solution, was shown, and the author of the paper asserted that the composition and amounts of these various compounds of iron and carbon were dependent upon two factors—namely, the original percentage of carbon in the iron, and the temperature at which the separations occurred. Above 1,135° C. and with carbon in excess of 4·3 per cent., only graphite separates out, while below these two limits in temperature and percentage of carbon, martensite, cementite, pearlite, and iron, in its three modifications of α, β and γ, are obtained in different combinations and amounts. The author also discussed the stability of cementite (Fe_3C) at high temperatures, and gave reasons for considering it an unstable compound.

The second paper read at the Friday morning session of the members was upon a somewhat similar subject, and was entitled "The Hardening of Steel in its Physico-chemical Aspects," the author being Prof. Heyn, of Charlottenburg. Prof. Heyn showed a large number of micro-photographs of prepared surfaces of steel upon the screen, to illustrate his contention that most valuable information could be obtained by the study of such polished and etched surfaces.

The crystalline grains and masses of ferrite, embedded in cementite and pearlite, can be distinguished in such micro-photographs, and these three constituents of steel vary in amount and arrangement during the various hardening processes.

The discussions on these papers were to have been taken together, but owing to lack of time they were postponed, and so far as the writer is aware, did not take place during the meeting.

The session of Friday afternoon opened with a paper by Dr. Löb, of Bonn, upon "Pyrogenic Reactions and Dissociation Phenomena." The author has devised an electrical method of heating organic compounds, which can be vaporised, to any desired temperature, and of studying the dissociation products which are obtained under such conditions. His apparatus consists of a flask connected to an air-pump, by means of which the liquid to be examined can be boiled under reduced pressure, and a small platinum coil fixed in the neck of this flask. By varying the size of this coil, and the intensity of the current passing through it, any desired temperature (within certain limits) can be produced and maintained, and in this way useful information has been obtained relating to the chemical constitution of certain organic compounds.

The deductions which the author draws from the results of his experiments are theoretical in character, and would not interest readers of this journal.

The next paper, by Dr. Rathenau, of the Allgemeine Elektricitäts Gesellschaft, Berlin, and the Bitterfeld Elektrochemische Werke, was a description of a new method of producing metallic calcium by electrolysis of the fused chloride. Exact details of the method, which has been worked out for the Allgemeine Gesellschaft by two of its chemists—Suther and Redlich—were not revealed, but Dr. Rathenau stated that its chief feature was the use of an interminable cathode. This rod-shaped cathode (presumably of graphite in the first instance) is placed with its end just touching the surface of the molten electrolyte, and as soon as a button of metallic calcium has formed and solidified upon it, the rod is raised vertically, and the button of calcium then functions as electrode.

This vertical motion of the cathode is repeated at short intervals of time, and an irregularly shaped rod of metallic calcium is thus obtained. A large number of such rods, measuring about 15 in. × ¾ in. in diameter, were exhibited by Dr. Rathenau, the metal being dark grey in colour, and like graphite to the touch. The production of metallic calcium upon an industrial scale by this method is said to be without any difficulties, and it only remains to find some practical applications in the arts and industries for the metal. Dr. Rathenau is convinced that such uses will be found, now that the problem of its manufacture on a large scale has been solved. There was no discussion upon this paper, but Dr. Muthmann stated that he could produce metallic calcium in any quantity, by electrolysis of a fused mixture of calcium chloride and fluoride, and that a new process was uncalled for.

Dr. Jordis, of Erlangen, followed with a paper upon "New Theories regarding Colloidal Substances." His paper was designed to prove that the colloids are not a class of substances totally differing in their physical and chemical characteristics from non-colloidal substances, and that Graham's views in this respect were incorrect. Graham, however, had pointed out, in his classic paper of 1861, that true views regarding colloids would be obtained by a study of their osmotic pressure constants, and Jordis and others have followed up this line of research, and have obtained results which are recorded in this paper. A lively and very lengthy discussion followed, and the interest of the modern German Privat-Docent in theoretical questions of this kind was strikingly manifest.

The next paper, by Dr. Müller, of Mulhausen, dealt with the "Passive State of the Metals," and here, again, an attempt was made to upset the old views regarding this phenomenon. According to the author, the presence or absence of positively-charged electrons or ions in the metal is the factor determining its activity or passivity; and the older view that the passive state is due to the action of the oxygen of the air is wholly incorrect.

Dr. Müthmann, of München, championed the older theory, however, and stated that all metals which exhibited

this property could be rendered active by polishing their surface, and thus removing the skin, or film, of oxygen compounds which protected them from action of the electrolyte. According to Müthmann, nine metals are now known which can assume the passive state, manganese and niobium being in some respects the most interesting of these.

A lengthy paper by Dr. Sackur, of Berlin, upon the "Alloys of Lead and Tin," followed. The author has considered the behaviour of these alloys in the presence of organic acids worthy of special study, owing to the extent to which they are now employed for the manufacture of vessels for domestic use. The results obtained by him in a large number of experiments are in harmony with the ionic theories of matter and solution, and show that both lead and tin are attacked in these alloys by acetic acid solutions. The relative solubility of these two metals is, however, dependent upon the concentration of the solvent. When dilute acetic acid is employed, lead is more soluble than tin, but in concentrated solution tin is dissolved more rapidly than lead. Similar experiments were carried out with other acids, and instructive results obtained.

The next paper, by Dr. Goldschmidt, of Essen, was upon "The Ruthenberg Process for Treatment of Iron Ores," and was one of the few papers read at the Bonn meeting dealing with the industrial application of electro-metallurgical methods. The Ruthenberg process, as our readers may know, is one for purifying and concentrating finely divided magnetic ores of iron, by means of electricity. The ore is passed between magnetic rolls, and while held in this position by its magnetic properties, it is exposed to the heating action of an electric current. This is said to remove all the phosphorus, part of the sulphur, and to demagnetise it, and the purified and "agglomerated" ore falls into a soaking pit, and is then ready for the ordinary reduction process. According to Ruthenberg, 250 KW.-hours will suffice to prepare 1 ton of ore, but Goldschmidt thinks this estimate too low. He recently had opportunity for inspecting the experimental plant at Lockport, N.Y., where the Ruthenberg process has been worked out, and he is somewhat disappointed with the small scale upon which the plant is operated. That the Ruthenberg treatment may be of value in preparing magnetic iron-sand and similar ores for the ordinary blast-furnace treatment, he is ready to admit; but he does not think the plan of reducing the "agglomerated" ore in a "soaking" pit by producer gas will be found economical or of industrial value. The Ruthenberg process is controlled by the Bradley patents, and by the Cowles interest in the same.

There was no discussion upon this paper, which was illustrated by photographs of the Ruthenberg furnace and works at Lockport.

Following Dr. Goldschmidt, Dr. Tammann, of Göttinger, read a theoretical paper upon the "Formation of Glass Crystals in Amorphous Masses of Glass," and then Prof. Mathesius, of Charlottenburg, gave his paper upon the "Formation, Constitution and Utilisation of Slags from Furnace Processes." The author dealt specially with slags which cannot be utilised, as in the case of sulphide slags, a second or third time in metallurgical reduction processes. These slags are generally silicates, and, according to the more recent researches of Vogt and others upon their constitution, only two base types exist, namely, ortho-silicates, of the general formula

$$R\left\langle \begin{matrix} O \\ O \end{matrix} \right\rangle Si \left\langle \begin{matrix} O \\ O \end{matrix} \right\rangle R,$$

and meta-silicates of the general formula

$$R\left\langle \begin{matrix} O \\ O \end{matrix} \right\rangle Si = O.$$

Referring to the utilisation of these silicate slags, which are produced in enormous amounts in the manufacture of iron, the author distinguished between Thomas slag, acid slags, and basic slags. The former, on account of its phosphorus contents, when ground, finds a good market as artificial manure, and the only difficulty in its preparation in this form has been overcome by the introduction of the ball-mill.

The acid silicate slags containing free SiO_2 may be utilised directly, either for making Portland cement, for building purposes, or as road metal. The basic slags, containing uncombined molecules of the base radical, could not formerly be employed with advantage in this way, but it is now customary in Germany to treat them with superheated steam, and then to use them for mixture with Portland cement made in the usual manner.

This paper concluded the first day's business, which commenced at 9 a.m., and lasted until 7.15 p.m., and the fact that the majority of the members present at the Bonn meeting survived this trying ordeal, and put in an appearance at the "Bier-Abend" the same evening, speaks well for the German electro-chemists' powers of physical endurance.

The Saturday morning session of the members was opened with a lecture by Prof. Ostwald upon "The Phase-Rule and Hylotropy." This lecture, to some extent, was a repetition of the ideas and theories of his recently delivered Faraday lecture, and contained the statement that the laws of chemical action and combination could be deduced without the aid of the atomic theory. With the aid of his conception of hylotropes, *i.e.*, bodies which preserve their identity and characteristics under all conditions, Prof. Ostwald showed that no definite line can be drawn between elements and compounds, and that these merge one into the other in a gradual manner. In the discussion upon this address, Profs. Van't Hoff, Roozeboom and Nernst joined, and the latter found himself in direct conflict with Prof. Ostwald upon some fundamental points of the new theory of matter and molecules.

The two papers which followed Prof. Ostwald's address were by Dr. Elbs, of Giessen, and Dr. Bredig, of Heidelberg, and dealt with "Stereometric Difficulties in Electrolytic Reductions," and the "Catalytic Action of Cyanogen Compounds" respectively. These papers were entirely of chemical interest, and abstracts of them would not prove of any value to readers of this journal. The next paper by Dr. Bose, of Göttingen, upon the "Chemical Action of Cathode Rays," was, however, of more general interest. Dr. Bose has been experimenting with the action of these rays, in an exhausted vessel of special design, using strong caustic potash solution as the chemical exposed to their influence, and current from a Tesla coil at 3,000 volts. Under these conditions he has found that the amount of hydrogen gas liberated is far in excess of that calculated by Faraday's law. Dr. Bose explains this discrepancy by bringing into the calculation the kinetic energy of the rays, and he shows that were the whole of this energy expended in chemical action, 1,800 $cm.^3$ of hydrogen, and a corresponding volume of oxygen, could be obtained from a current, of which the electro-chemical equivalent would only be ·116 $cm.^3$ hydrogen.

The final paper of the morning session was contributed by Dr. Trautz, of Freiburg, and dealt with "Luminous Phenomena in Chemical Reactions." The author cited a large number of cases, in which luminosity is produced during chemical reactions, this being, as a rule, overlooked, because the reactions are not carried out in a darkened room. Two striking experiments were made by the author, to show the intensity of this phenomenon at the moment of reaction, and it was stated that the intensity of the luminous effect was, as a general rule, in direct ratio to the speed of reaction.

The afternoon session of Saturday, May 14th, was entirely devoted to papers of medical interest, the following being read and discussed :—

1. "The Relation of Freezing Point Determinations to Medical Science," by Dr. Schroeder, Bonn.

2. "Freezing Point and Conductivity Determinations in their Pharmacological Aspects," by Dr. Dreser, Elberfeld.

3. "The Chemical Mass Action of Toxines and Antitoxines," by Prof. Arrhenius, Stockholm.

4. "The Action of High Potential Electric Currents on the Nervous System," by Prof. Nernst, Göttingen.

A very large attendance of medical men was secured at this session of members of the Society, and the papers were all listened to with great attention and interest. That by Prof. Arrhenius caused the most lively discussion, since many representatives of the older view which Prof. Arrhenius was attacking were present, and joined in the after proceedings.

Briefly, it may be stated that Prof. Arrhenius, as the result

of a long series of laboratory investigations, has come to the conclusion that toxines and anti-toxines, when introduced into the animal or human organism, follow the usual laws of chemical reaction; while Prof. Ehrlich, of Frankfort, and other workers in this field of research, believe that the action of these bodies is peculiar, and not governed by the ordinary laws of chemical action. The importance of this subject lies in its relation to the new serum treatment for combatting diseases which are due, in the first instance, to the poisons produced in the system by certain forms of bacterial life and activity.

In concluding this report of the Bonn meeting, it may be remarked that the social features of the meeting comprised a reception in the Lese-Anstalt on Thursday evening, a "Bier-Abend" in the Beethoven Hall on the Friday evening, a dinner on the Saturday evening, and an excursion to Drachenfels on the Sunday. All of these functions were numerously attended, and passed off well, the dinner on Saturday being especially successful.

English science was honoured during the meeting by the election of Sir Henry Roscoe and Sir William Ramsay to honorary membership of the Bunsen Society, and it was noticeable that the latter chemist, owing to his recent work on argon, helium, and radium, commanded a very high place in the estimation of German chemists and scientists.

GAS ENGINE TESTING.

A PAPER presented by Mr. W. P. Flint to the June meeting of the American Society of Mechanical Engineers, recommends the brake in place of the indicator. The brake the author considers equally applicable to large and small engines, but he speaks of 300 B.H.P. as large, and it does not appear whether he would use a brake on even larger engines, though there are no mechanical reasons why it should not be done.

The usual water channel is advised for the rim, and the brake wheel is advised to be lubricated with strips of fat salt pork, which fry slowly and keep the wheel greased. The brake lever is simply to be rested on a scale platform, and the brake screwed up with a tension screw. These clip brakes have not much of a reputation for steadiness, and we note that a man with a spanner has to stand by all the time to keep the load constant.

As a standard of comparison, he measures the suction displacement per minute of the engine and reduces all the figures of the test in the ratio of this displacement to the arbitrary figure of 345 cb. ft., which he regards as the suction displacement of an engine that will give a rated horse-power of 100 when working on natural gas, and of 115 maximum B.H.P. He writes "in the neighborhood of" 115 B.H.P., by which we suppose he means "about," using four words of properly 20 letters instead of one word of five letters. As a concession to American brevity, however, he spells the longest word wrongly. The figures for 100 H.P. are then plotted and the curves of all engines are brought down to a sort of common basis.

The author confesses to the difficulty of knowing what is the temperature of the mixture in the cylinder prior to compression commencing. The heating of the air and gas during admission prevents the full suction displacement being realised, and this fact, of course, limits somewhat the power of an engine of a given size.

The author discusses the heat capacity per cubic foot of mixture. The gas itself, if pure CH_4, contains 1,015 B.Th.U., or, omitting the latent heat of the water formed, 915 B.Th.U. With a mixture of one gas to 10·45 of air the heat units per cubic foot are 80, and out of 345 cb. ft. of suction displacement at 115 B.H.P., it is assumed that 2 per cent. is lost by the 2 per cent. fewer revolutions at maximum load, another 5 per cent. is lost by partial vacuum, and there is a further 22 per cent. lost by increased volume due to temperature. Thus only 250 cb. ft. are really drawn in at standard temperature and pressure.

Then $80 \times 250 = 20{,}000$ B.Th.U. per minute for 115 B.H.P., whereas $115 \times 42{\cdot}4$—the theoretical heat value of 1 B.H.P. minute—gives 4,870 B.Th.U., or 24·35 per cent. efficiency. This makes 10,430 B.Th.U. per B.H.P.-hour in good practice. The author considers that much help in the study of gas engine performance will be gained by plotting results in the above manner to a basis of 100 H.P. rating, or 115 B.H.P. maximum.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"TYNE PYE" writes:—"A company owning iron-works are desirous of providing electric power to about five of their collieries, which are situated at distances varying from one to five miles from their works. It is proposed to lay down H.T. plant—say 2,000—6,000 volts—at these works, and convey the current by bare overhead wires to the various collieries—the total amount of power required being on the average 1,000 H.P. These wires would, in a few cases, have to cross public roads and footpaths, and a railway or two, but for the greater part of the way the poles could be erected in fields occupied by tenants of the company. Could such a scheme be carried out, supposing the consent of the various public bodies and private individuals were obtained? Would the Board of Trade object in any way to the use of bare wires, and if so, what is the highest pressure they will allow in bare wires?"

*** It will be competent for the colliery company to carry out their scheme without any Provisional Order or special Act. They can certainly carry wires over the roads with the consent of the local authorities, and it is not generally even necessary for them to obtain that consent. The jurisdiction of the local authority (as highway authority) over a road only extends to the keeping of the surface of the road free from obstruction, and if the cables are stretched across at a sufficient height, and are supported by posts placed upon land of the frontagers on either side, the local authority has no power to interfere. There is only one word of caution to be sounded here, namely, that if by any chance the soil of the road—or, in other words, the fee simple of the road—is vested in the local authority, that body can apply to the Court to prevent the cables being put into position. It is probable, however, that in the district in question the soil of the highway belongs to the frontagers, in which case "Tyne Pye" will experience no difficulty.

With regard generally to the laying of electric lines by persons who have no provisional order, it is provided by Sec. 4 (1) of the Electric Lighting Act, 1888, that when it is proposed by any person to lay such lines, notice of the intention to do so must be given to the Board of Trade, who have made important regulations on the subject. A copy of these can be obtained from Messrs. Eyre and Spottiswoode, London, E.C., for a few pence. Clause 10 provides that "every high-pressure conductor laid or erected *in any street* after the date of these regulations shall be continuously covered with insulating material to a thickness of not less than one-tenth of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulating materials shall not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000." The other regulations are too long to be set out here. "Tyne Pye" will do well to submit a plan of his proposed works to the Board of Trade before he commences to execute them.

PARLIAMENTARY.

CHARING CROSS, EUSTON AND HAMPSTEAD RAILWAY.

THIS Bill, which has already passed a House of Commons Committee, came before a Committee of the House of Lords, presided over by Lord Hawkesbury, on June 14th. The promoters were represented by Sir R. Littler, K.C., Mr. Balfour Browne, K.C., Mr. Roskill, K.C., and Mr. G. Gitzgerald. Messrs. Meux's Brewery petitioned against the Bill, being represented by Mr. Freeman, K.C., and Mr. Courthope-Munroe.

The case for the promoters was opened by Mr. BALFOUR BROWNE. He explained that the company had been authorised to construct a line of railway from Charing Cross to Golder's Green, with a branch through Camden Town to Highgate Hill. It was proposed to extend the limits of deviation at Charing Cross for the construction of the terminus, and also to construct a station in the neighbourhood of the Cobden statue, and to these proposals there was no opposition. Messrs. Meux's opposition was to the proposal of the company to take a portion of the cellarage of their brewery in connection with the construction of certain subways, which the

company were compelled to make for the convenience of the public.

On Wednesday, June 15th, the opposition of Messrs. Meux was considered, a number of witnesses being called to show that the firm would suffer damage by the proposed exit.

Superintendent Bantick, of the D Division of the Metropolitan Police, stated that the proposed exit would be very inconvenient. It was not in a suitable place, as the pedestrian and vehicular traffic was particularly heavy at that point.

Mr. Freeman, K.C., then addressed the Committee on behalf of the petitioners.

After consultation the Committee found the preamble of the Bill proved.

Baker Street and Waterloo Railway.

A Select Committee of the House of Lords, presided over by Lord Hawkesbury, met last week to consider this Bill. Mr. Balfour Browne, K.C., Mr. Roskill, K.C., and Mr. Shaw represented the promoters; the opponents, the London County Council, being represented by Mr. Erskine Pollock, K.C., and Mr. Talbot.

Mr. Balfour Browne, in opening, said that the railway was already authorised from the Elephant and Castle to Paddington, and the greater portion of the line between Baker Street and Waterloo had been constructed. There was no objection to the proposals in the Bill for the acquisition of land in Westminster Bridge Road and Regent's Park, for the purposes of stations and for the enlargement of the tunnels under Westminster Bridge Road and Edgware Road. To carry out those and other works, the company found themselves compelled to raise further capital, and the Bill authorised the issue of £288,000 share capital, with borrowing powers to the extent of £96,000. The London County Council objected to the granting of these further capital powers, and alleged that the present authorised capital was sufficient. He would call the engineers, who would tell the Committee that the improvements proposed under the Bill would make the railway more useful to the public, and that the additional capital they were asking for was absolutely necessary for their execution.

Mr. Galbraith and Sir Benjamin Baker, the joint engineers, gave evidence bearing out counsel's opening statements, and explained that the additional capital sought was to be expended as follows:—£10[illegible],000 for land, £176,000 for extra equipment, and £40,000 for sundry works which consisted chiefly of the provision of additional protection against fire.

Mr. E. Bruce Read, the secretary to the company, said that the total authorised capital of the undertaking was £3,179,000. The original contract price was £3,960,000. Up to March 17th last, £1,522,000 had been expended on construction, and it was estimated that a further £1,486,510 would be necessary to complete the line. Replying to Mr. Talbot, the witness said that the general public held about £400,000 of the capital already issued, and the Underground Electric Railways Co., who were the contractors for the line, held one million. He was not prepared to admit that the control of the railway was in the hands of the Underground Co. It was true there was an intimate connection between the two companies, but the policy and finance of his company was in the hands of a separate board of directors. It was impossible to say what the profit of the Underground Co. would be until they had finished the line. So far, all the payments had been in the way of shares.

Mr. Talbot asked the Committee not to allow the Bill to proceed, as, he submitted, it had not been shown that the existing borrowing powers of the company were exhausted. The Underground Co. was really the Baker Street and Waterloo Co. under another name, and it was not enough that the company should say that they had handed their capital over to another company, who were not really independent contractors.

The Committee found the preamble of the Bill proved.

Derbyshire and Nottinghamshire Electric Power Bill.

This Bill came before the Chairman of Ways and Means in the House of Commons on Friday. There was no opposition from petitioners, but reports were presented by the Board of Trade and the Local Government Board.

Mr. Freke, who represented the promoters, said the Bill was promoted by the company who had powers to supply a very large area, and it was to enable the period for the commencement of the work to be extended; to enable interest to be paid out of capital; to allow of the transfer to the company of electric lighting provisional orders of local authorities, &c. Clause 2 was the most important clause dealing with the transfer of electric lighting orders. The Board of Trade, under the Electric Lighting Acts, granted orders to companies and to local authorities. In some of the orders they gave powers to transfer, while in other cases they did not. One of the main objects of the power company was to provide electricity to local authorities having electric lighting orders, so that the local authorities might save themselves the expense of erecting generating stations, but experience had shown that when they approached the local authorities, in many cases these authorities said: "Why not take over the order and distribute it too?" The power company was willing to do this, but when dealing with a local authority whose order did not specify that it might be transferred, they hardly knew the position. Last year the question was raised in the Cleveland and Durham and in the South Wales cases. After a good deal of discussion with the Board of Trade and the House authorities, they came to this position—that while the Board of Trade altered their view, with regard to transfer, to the extent that they thought facilities should be given, under the circumstances, for these power companies to take transfers, yet they were not prepared to tie their hands in the future. Consequently the clause in the Cleveland and the South Wales Bills was framed so that the power companies were only allowed to take the transfer of orders which had already been granted. Clause 2 in the Bill before the Committee that day read as follows:—"The company may by agreement (but not otherwise) acquire from any local authority, or other undertakers, to whom a provisional order under the Electric Lighting Acts, 1882 and 1888, shall have been, or may be, granted, relating to a district or place within the company's area of supply, the undertaking authorised by such provisional order, and the property, powers, rights, authorities, and privileges of the undertakers under such provisional order has been, or may be, granted, may with the approval of the Board of Trade, transfer their undertaking, property, powers, rights, authorities, and privileges to the company on such terms and conditions as may be agreed upon, and in the event of the company so acquiring such undertaking, property, powers, rights, authorities and privileges, they shall be deemed to be the undertakers for all the purposes of the provisional order so acquired by them, and the provisions of such provisional order shall apply to the supply of electricity by the company within the area of supply as defined by such order, and the company shall be entitled to charge for electricity supplied within such area, the prices prescribed by such order. Provided that in the case of any provisional order granted prior to the year 1900 to any local authority, the provisions of the Electric Lighting (Clauses) Act, 1899, shall, from and after such transfer, be deemed to have been incorporated with such provisional order, and shall control and supersede such of the provisions of that order as are at variance or inconsistent therewith. (2) Any capital moneys received by any local authority in respect of any transfer under this section, shall be applied by such authority in manner provided by sub-section 2 of section 7 of the schedules to the Electric Lighting (Clauses) Act, 1899."

The Board of Trade suggested that the powers should be limited to the transfer of orders granted prior to the passing of the Bill, and this the promoters had provided for. With regard to the Local Government Board, they suggested that the clause should be modified, so as not to confer powers on the local authorities, but only on the company, and the Board submitted that under Sec. 11 of the Electric Lighting Acts, the Board of Trade had power to transfer an electric lighting order from one body to another. However, the Board of Trade, rightly or wrongly, would not grant the transfer of undertakings under that section, and therefore he hoped the Committee would allow the clause to go through. If they did not get the power by the clause, it would lead to considerable delay in getting orders transferred.

Mr. Saunders was called to prove the preamble, and the Committee allowed the Bill to go forward.

Maidenhead Electric Lighting.

On June 16th and 17th a Select Committee of the House of Lords, under the chairmanship of the Duke of Northumberland, considered the Maidenhead Electric Lighting Order contained in the Electric Lighting Orders Confirmation Bill (No. 3).

Mr. Balfour Browne, K.C., appeared for the promoters, and said the object of the order was to extend the area of electricity supply of the Maidenhead Corporation outside the municipal borough. The position was a curious one, inasmuch as the Board of Trade had put it upon the Corporation to supply a larger area than they asked for. Really the Corporation did not want to supply the extra area, and it was only on the representations of the Eton Rural District Council that it had been included. The Great Western Railway Co. was opposing the extension to these districts as ratepayers, and the Corporation itself supported that opposition, for it did not want to supply to Hitchin and Burnham. The other opposition came from the Maidenhead Gas Co., who asked for the insertion of the Bermondsey clause in respect of these outlying districts. The clause asked for was as follows:—"The undertakers shall once in every year, after the first year's working of the undertaking, cause to be laid before them a statement and balance-sheet of the accounts of the undertaking, drawn up in accordance with the form of accounts prescribed by the Board of Trade for a local authority under the Electric Lighting Acts, 1882 to 1888, and the undertakers shall thereupon fix annually the charges to be made for the supply of energy in the then ensuing year at such rates not exceeding the maximum rates specified in the Order, so that, as far as is reasonably practicable, the revenue for the year shall not be less than the expenditure." The Corporation already supplied the borough under an Order of 1896, and so its opponents could not ask for the clause in respect of the existing undertaking. The clause asked for was inserted in the Bermondsey Order some years ago, and he was the counsel who moved for its insertion, but now they had to face an altered state of things. In the early days there was a great deal of suspicion as to the way local authorities carried on the business of electricity supply. Now it was decided in favour of allowing the local authorities to supply, and no sane man would say that the imposition of such a clause as this would leave the Corporation a free hand to carry on their business in a commercial manner. While he must admit that there were precedents for the imposition of the clause, yet there were an equal number of precedents in a contrary sense. He contended that the clause was utterly wrong in principle, and he asked the Committee to refuse it altogeter, because the Corporation did not want it, even in a modified sense.

Mr. Alderman Hobbis, Mayor of Maidenhead, gave evidence in support of the Bill. In cross-examination by Mr. Paddon, who appeared for the Gas Co., witness denied that the electricity accounts were not kept in a proper form. As a matter of fact, they were set out in the form prescribed by the Board of Trade. He did not agree that if the Corporation's electricity accounts were set out in the same way as those of a company that they would show a loss of £2,000.

Mr. H. Burstall, consulting engineer to the Corporation, also supported the application. He said there were already several applications for current in the outside districts, and he was convinced that the undertaking would pay.

Mr. C. O. Milton, borough electrical engineer, gave evidence as to the success which had attended the undertaking of the Corporation. His experience was that, if no applications were made for current, yet if the mains were laid in a street, practically all the houses along the route soon became connected.

Mr. Paddon addressed the Committee on behalf of the Gas Co., and contended that electric lighting was not a fit subject of municipal enterprise, but that, if local authorities did engage in it, they should be compelled to do so on those sound commercial principles which governed every private undertaking.

The Chairman announced that the Committee would reserve their decision on the point until after considering other orders.

Maldens and Coombe Electric Lighting.

On Monday the Select Committee of the House of Lords, under the Chairmanship of the Duke of Northumberland, proceeded to consider the confirmation order to the Urban District Council in respect of the Maldens and Coombe, in the county of Surrey, contained in Electric Lighting Order, No. 6 Bill.

Mr. C. C. Hutchinson, on behalf of the Kingston Gas Co., asked that the Committee should insert in the order the Bermondsey clause, or some clause similar to that. He maintained that Parliament never contemplated that the local authority should set up to supply electricity at a loss.

Mr. Wedderburn, K.C., said this was an order to empower the local authority to start an electrical undertaking, and the position before the Committee was, that it was a new undertaking, and in that way it differed from the Maidenhead order. He would find it difficult to add very much to the practical common sense which had been put before the Committee by Mr. Balfour Browne, who had described himself as being in a repentant spirit. He would differentiate the different classes of cases to which the principle might apply. There was first the case of new undertakings where the local authority asked simply to carry on operations in its own locality, and the case of Malden and Coombe came under that head. Secondly, there was the case of an existing undertaking not confined to its own area; and, thirdly, there was the case of an old undertaking not confined to its own area making a loss. He understood the chairman of the Committee to say that two elements, one of which was loss, had to be present in order to make the clause apply, and the second that the local authority should be supplying at a loss outside its own area. Where they had got an absolutely new undertaking by a local authority, he submitted that on these two grounds there was no cause for imposing the clause.

The Chairman said he did not remember expressing any opinion of the kind.

Mr. Wedderburn said he understood the chairman to state that the principle points to be considered, were whether the local authority was going outside its area, and whether it was carried on at a loss.

The Chairman said he made remarks to that effect before the cases were opened, but that must not be taken as an expression of the views of the Committee.

Mr. Wedderburn said he took it, he might say, that one of these elements must be present in any case. In the Malden case it was a new undertaking, and confined to its own area, and the question of adding the clause did not depend on two of the main arguments put forward by Mr. Paddon in the Maidenhead case. The two arguments put forward by Mr. Paddon were that, if a local authority chose to set up as a trading authority, and to go outside its own area, the fact that it did go outside was a proof that it ceased to be a local authority, looking after its own people, but that it was purely a commercial undertaking, and that if, by so doing, there was a loss, it was not fair that that loss should fall on the people inside the area. Another argument adduced was that a loss on the working was, in itself, evidence of mismanagement, and in almost every one of the petitions of the gas companies they found the expression used that the electric lighting undertakings of the local authorities were ill-conceived, and that they were conducted on unsound and perilous lines. The question might arise, in the case of a local authority going outside its own area, or in a case where there had been a loss, but there was absolutely no reason why a new undertaking should be saddled with what was a penal clause. It would be in the nature of giving a dog a bad name and then hanging him. So far as the undertaking was a new one, he submitted that the question before the Committee was: "Is the local authority to be allowed to trade?" and that had been decided both by the general law and by the Board of Trade. It seemed to him that a great deal of the argument put forward for the Bermondsey clause mixed up that question, which had already been decided by the Board of Trade and the general law. It was not to be assumed that the Malden people were going to be reckless or uncommercial, and the Board of Trade and the general law assumed in granting them the order that they were capable of carrying it out on commercial principles, and until it was shown that they could not do this, they ought not to be saddled with such a clause, and he asked the Committee to find that it was not in accordance with public policy that the clause should be inserted in the order. To insert it would be inconsistent, because it was saying on the one hand, that the public authority should be entrusted with the order, and on the other hand, that they were not fitted to carry it out. If such a penal clause was to be inserted, then it would seem that the order ought not to be granted at all. The real question was not whether or not such a clause kept the local authority in order, but whether such a clause tended towards profit or loss. If it could be shown that the clause helped the local authority to a profit, it was a good clause, but he endorsed the views of Mr. Balfour Browne that it tended more to loss than to profit. It was a purely business question, and he ventured to deprecate the issue being complicated by trying to make it a class question. He deprecated all the talk of electricity being a luxury for the rich, and asked that the matter should be treated solely as a business one.

Mr. Balfour Browne said that with regard to a loss being due to mismanagement, it was shown that there was a loss on the first year's working, but it was a loss which was contemplated.

Mr. Hutchinson said he had great sympathy with Mr. Balfour Browne. He could imagine that Mr. Browne's feelings must be like those of the Roman father, who, by the early Roman law, was obliged to expose his child, as Mr. Browne had done, to the inclemency of the weather, thinking that, probably, it would not survive the trial.

Mr. Balfour Browne: Are you the weather?

Mr. Hutchinson said Mr. Wedderburn had missed his argument, for there was nothing in the Bermondsey clause to prevent a local authority making a profit. So far as he was able to see Parliament never intended that the local authority should become a municipal Whiteley, and Parliament had imposed limitations in respect of the so-called trading in the various commodities that the local authorities were allowed to engage in. But whatever the position of the local authority might be in respect of other commodities, there was a marked distinction and difference to be drawn in respect of the management of an electrical undertaking. When they came to tramways Parliament drew a distinction, and said that the local authority must come and show that it would be to the advantage of the district that powers should be granted and that it was likely to be a profitable undertaking. In the case of the Aberdeen and Dundee tramways similar provisions were imposed on the undertakings as were asked for in the cases now before the Committee, namely, that as precedent to the power being given, the undertaking should be made self-supporting. The supply of electricity was not a necessity of life, and there was a marked distinction to be drawn between the supply of water or gas and the supply of electric light, and he did ask for the insertion of the Bermondsey clause or some other words which would put it on the local authorities to make the industry self-supporting. He was not going to say on behalf of the Gas Co. he represented that they were not to be subjected to competition. He agreed that Parliament had decided, subject to some restrictions, that local authorities might supply electrical energy in competition with gas companies, and Parliament had gone so far in Sec. 29 of the Electric Lighting Act of 1882 as to consider that competition under some circumstances might be even disastrous to the undertaking of the gas company, because it was provided under that section that where a gas company in consequence of the competition of the electric light could not be carried on to advantage, the gas undertakers might go to the Board of Trade and be relieved of their powers. But the existence of that clause was all the more reason why those who had supplied gas and had embarked their capital in gas undertakings should not be subjected to unfair competition as would inevitably render their undertakings valueless. He was not going to ask that the absolute form of words of the Bermondsey clause should be inserted, nor did he maintain that the working of the clause was the best way to provide that the municipal electrical enterprise should be made self-supporting, but at a later stage he would suggest a clause.

The Tamworth Order.

Mr. Wedderburn, K.C., opened the case for the Tamworth Order in No. 2 Electric Lighting Bill, and said it was of the same class as the Malden Order, and the local authority, which had not hitherto supplied electrical energy, was seeking by the order to supply in its own area only. In opening the case, he need only reply to Mr. Hutchinson's remarks in the previous case, but he frankly admitted that a good deal of Mr. Hutchinson's arguments he did not understand. It seemed to him that almost the whole of Mr. Hutchinson's argument went to show that an endeavour was made to mix up two things, viz.:—"Should the local authority be allowed to trade in electricity at all, and, if so, are they to be fettered?" It was said that the competition was unfair, but that must depend on evidence. It could not be unfair in principle, because it had already been decided that the local authority should be allowed to supply electricity, and so the sole question was whether the Committee were going to fetter the undertakers or not. If it could be proved that the local authority fixed the rates absolutely low to destroy the gas company, he could easily understand Parliament saying it should be fettered, but that was a matter of evidence, and here they had no evidence at all. They had heard that the Bermondsey clause was a bad one, and it was evident that the initial period in which a local authority should be allowed to try and make a profit must be considered in each individual case. In some cases five or six years might not be sufficient, and they could not lay that period down as a general principle.

Eastleigh Order.

The order to the Eastleigh U.D.C. in No. 2 Bill was next taken, and Mr. Wedderburn, K.C., said the circumstances were identical with the Malden and Tamworth orders.

Mr. Neville, who appeared for the local gas company, said he desired to associate himself with all that Mr. Hutchinson had said, and also wished to point out that Mr. Wedderburn was really begging the question when he said they were trying to mix up two things; the fundamental position he took up had been defined by the Joint Committee on Municipal Trading which reported last year. That Committee did not deal with the whole question of municipal trading, but confined itself simply and solely to the one question of accounts, and the finding of this Committee was very material when they were dealing with such a clause as the Bermondsey clause. The fundamental finding of the Joint Committee was that wherever municipal trading existed, the ratepayers should be fully as frequently informed of the position of the undertaking, as if they were shareholders in a commercial undertaking. The ratepayers now were not in the position of shareholders, although they ought to be. In the first place, with regard to these provisional orders, their consent was not necessary, and the ratepayers were not consulted. His second point was that great corporations, such as railway companies, were not assessed like other ratepayers, and the burden of the rates in many places pressed heavily upon them. They, therefore, who were affected by this form of trading, asked that a clause like the Bermondsey or the Marylebone clause should be inserted, in which a time limit should be fixed, during which the local authority should try and make the undertaking profitable. In the case of Marylebone, three years were given the local authority to set their house in order, and then they were obliged to charge a price which would prevent a loss. There were a large number of electrical undertakings carried on by the local authorities in this country at a loss, and the only opportunity which presented itself for getting such a clause inserted in most cases, was when the Bill first came before the Committee. He contended that at least it should be obligatory upon the local authority to get the consent of the ratepayers before borrowing money for the undertaking.

Mr. Wedderburn, K.C., in reply, pointed out that the Marylebone case was a peculiar one. The local authority had to purchase the existing undertaking, and, at the very start, were saddled with a heavy responsibility. But, even in that case, Parliament weakened the Bermondsey clause, for they gave a period of three years before the obligation to revise prices came into operation, and they omitted forward contracts from the revision. He submitted that the case of Marylebone was fatal to the Bermondsey clause.

The Hanwell Order.

Mr. Neville asked that the Bermondsey clause should be inserted in the order to the Hanwell U.D.C.

Mr. C. E. Allan, who appeared for the promoters, said it was a new order, and applied only to the U.D.C.'s own area. They felt that the insertion of the clause would throttle the undertaking at its very start. With regard to the suggestion of Mr. Neville, that money should not be borrowed without the express consent of the ratepayers, he pointed out that there was a local inquiry by the Local Government Board, and it was competent for ratepayers to be present and raise objections. Councillors also had to go to the ratepayers to be elected, and the Council meetings were open, and the Press were admitted, so that the local authority could do nothing which was opposed to the public feeling of the district. With regard to Hanwell itself, it was a rapidly growing district, and they would like to put down plant and erect a generating station sufficient to meet anticipated requirements a few years hence, and therefore, unless the limit was a wide one before they had to fix prices to meet expenditure, it would be extremely difficult to carry out the work.

Mr. Neville replied, and said the Local Government Board inquiry was simply as to borrowing money, and not as to what it was wanted for.

Mr. Wedderburn pointed out that in the case of Eccles, where the Board of Trade had granted a provisional order, the Local Government Board twice refused to allow the money to be borrowed.

Mr. Neville said that if the Hanwell district was such a growing one, the undertaking would be successful, and therefore the Hanwell U.D.C. had no need to fear the clause.

Watford Order.

Mr. Wedderburn, who opened the case in respect of the Watford order, said the circumstances were somewhat different. The Watford U.D.C. only supplied its own area, but it traded at a loss. The provisional order was obtained in 1897, and the works were completed in 1899. The urban district was extended in 1901, and the order now before the Committee had reference to the inclusion of that area. The average loss, apart from the repayment of sinking fund instalment and interest, was £198 a year, but, of course, that small loss raised the question as to whether there had been mismanagement. Was the mere fact of loss to be held as evidence of mismanagement, and was the clause then to go into a Bill? If so, was the clause to go into every one of the orders before them, whether they were opposed or not?

The Chairman said he believed it would be within the wish of the Committee to have evidence from the Board of Trade.

Sir Ralph Littler, K.C., asked that counsel should be heard after the adviser of the Board of Trade had been called.

The Chairman said, as he understood it, the Board of Trade was against the Bermondsey clause.

Mr. Page, K.C., who was interested in the Doncaster Bill, asked what the position would be if the Committee decided to put the clause in the orders. Would he have the opportunity of arguing on the Doncaster Bill?

The Chairman said every Bill must be decided on its merits.

Mr. W. H. Turner, clerk to the Watford U.D.C., was called, and gave evidence as to the progress of the electricity works. The total deficiency on the undertaking since the commencement was £4,068, but £4,434 of this had gone in repayment of principal and interest. This year the loss had been reduced to less than ¼d. per unit.

Cross-examined by Mr. Paddon: His objection to the clause was that there would be a difficulty in applying it.

Re-examined by Mr. Wedderburn: In the absence of any evidence as to mismanagement, he considered the clause unnecessary. There was no reason why the clause should be put upon them.

Mr. W. H. F. Colebrook, the resident engineer to the Council, was then called.

Cross-examined by Mr. Paddon he said that he was not responsible for the accounts.

Mr. Paddon then addressed the Committee in opposition. He said that he considered there had been mismanagement. There had been a deficiency. They had endeavoured to dispose of a large amount of electricity without regard to the ratepayers, and the amount lost did not include the whole of their indebtedness. The Council had been hawking the undertaking about and endeavouring to dispose of it. They were selling at fanciful prices, such as no private concern could afford to sell at. There was another clause for which he wished to ask. He would ask that when the Council wished to raise further money they should be obliged to consult the ratepayers, for in the ratepayers' interests some limitation was necessary, and if they had that clause it would benefit the ratepayers.

The Bath Order.

At the end of counsel's speech the Bath Confirmation Order was considered.

Mr. Hutchinson (for the Rural District Council) said that the order was different from any of the others. He would open his case by calling evidence.

Mr. Fippard, the engineer, was then called. He said that he knew the district proposed to be supplied well. It had an area of 27,420 acres, with a population of 27,672. There were two collieries and a number of factories in the area of supply. He considered that the district was quite suitable for an undertaking of that kind. They did not propose to erect a generating station, but to take a supply in bulk from some other authority. There was the Somerset and District Electric Power Co., but they had other means. The Bath Corporation and the Bath Tramway Co. could both supply them. The Corporation had mains running into the district, and all they would have to do would be to lay their own distributing mains. He estimated that the number of customers in the first year would be 4,000, and in the second year 7,000. The price per unit would be 4·75d., and the cost of manufacture 3·5d. The first year's working would show a deficiency of £63, but the second year would about balance. After that he was of opinion that the undertaking would be remunerative.

Cross-examined by Mr. Baggallay (for the Bath Gas Co.) He could not say what proportion of the population was in the compulsory area, the area in which they had to lay their mains within two years. He did not know how many premises were rated at over £50. He admitted that the Tramway Co. had no power to supply the Council, and he could not say if the Bath Corporation could supply them to any great extent. The supply would be distributed from distributing stations, of which the first would probably be at Weston. He had got no estimates out. No greater length than one mile of main would in any case be necessary.

Mr. Bolwell, surveyor to the Council, said that he considered that all the property in the compulsory area was likely to be supplied with electricity.

Mr. Baggallay, addressing the Committee for the gas company, said that this was a case where the order ought not to be confirmed, or, if confirmed, should be confirmed subject to a clause of the nature of the Bermondsey clause. The danger was that the local authority would not be able to run the undertaking on commercial lines.

The Committee adjourned.

The Chairman asked Mr. Pelham, of the Board of Trade, to state what was the attitude of that body to the clause.

Mr. Pelham said that, in 1902, the Board of Trade refused to insert the clause in the absence of any instructions from Parliament. Sometimes the clause was put in by agreement, but that was generally in the case of an older authority. The Board of Trade's main objection to the clause was that it did not seem calculated to attain the object in view. Then it was difficult to define what the first year's working was. The Act provided that any profit up to 5 per cent. was to go to the ratepayers, and a local authority might find themselves with a profit of 4 per cent., which would be a clear profit to a company, but not a profit to the local authority.

Colney Hatch Order.

On Tuesday, Sir Ralph Littler, K.C., as representing the Colney Hatch Gas Co., addressed the Committee on the provisional order relating to the Colney Hatch Council. He said that the doctrine laid down by the Board of Trade was that the Bermondsey clause

was wrong in principle, but he objected to any public department having power to lay down such a rule with the object of excluding discussion upon it before Parliament. The views of the Board of Trade with regard to the clause were fallacious. It was absurd to say that the best way to reduce loss was reduce prices. Municipalities were at present uncontrolled in the matter of electricity supply, and the ratepayers, who were the compulsory shareholders, had not even the authority with regard to the undertaking that a shareholder in the gas company had. A simple answer to all objections to the clause was that if the undertaking were successful, the clause could do no harm. In his own case the District Council, after having fully discussed the matter with the gas company, had agreed that the clause should be inserted in the order. Yet the Board of Trade stepped in and objected to it. He asked the Committee to insert the clause agreed to.

The Huddersfield Order.

The Huddersfield Order was next taken, and Mr. Baggallay, K.C., addressed the Committee on behalf of Huddersfield Corporation. The Corporation, he said, had at present the electric lighting undertaking within the borough, but the proposal of the Order was to extend it into Golcar. The Longwood Gas Co. had petitioned against the Bill, but had now withdrawn in view of the fact that the Corporation had inserted the Bermondsey clause in respect of their undertaking. The Board of Trade objected in the same way as they did in the Colney Hatch Order, and he asked the Committee to over-ride that objection.

This concluded the Orders in the Confirmation Bills before the Committee; before considering the Doncaster Corporation Bill, in which the question of the Bermondsey clause was also to be raised, the Committee deliberated in private, and, on resuming, the Chairman announced that the preambles of all the Bills would be proved. With regard to the question of the Bermondsey clause, he asked the various Counsel to bring up a clause carrying out the following provisions:—The accounts of the undertakers to be published annually in the form prescribed by the B. of T. under the statute. The local authority, at the end of five years after the undertakers supply energy in the case of a new, and of three years in the case of an existing, undertaking, and thenceforward triennially, shall so far as is reasonably possible revise its rates, so that no loss shall be incurred by the ratepayers on the undertaking. Nothing to prevent a local authority from entering into a contract to supply electrical energy on special terms, but the rates charged in future contracts to be either subject to revision at the triennial revision or rise and fall (but not, excepting by consent, below any minimum named in the contract) *pari passu* with the general electric lighting rates fixed at the triennial revision, the promoters in each case to decide which of the alternatives they preferred to be inserted in their order. The Committee did not intend to prevent or discourage a more frequent revision of the rates, other than the contract rates, should a local authority desire to enter upon it. The clause was not to be drawn so that it could be interpreted as to prevent a revision annually or bi-annually.

Sir Ralph Littler undertook to draft and bring up the clause on the following day.

Doncaster Corporation Bill.

The Committee then proceeded to consider the Doncaster Corporation Bill. Mr. Balfour Browne, K.C., who opened the case for the promoters, said that it was proposed to supply electricity to a number of districts outside the Borough of Doncaster, the local authorities of the various districts being all consenting parties. The authorities in question were little likely to get a supply of electricity, unless the Corporation supplied them. The Bill was petitioned against by the Yorkshire Electric Power Co. That company started with the object of supplying local authorities in bulk, but they came into existence on the undertaking that they were not to have a monopoly of the district. The company got their Act in 1901, but at present they had done little under it, and were not within miles of the disputed area. In the circumstances he thought that the powers sought by the Corporation should be granted to them, and that the protection sometimes given to gas companies, should not be given to the petitioners.

Mr. Wyld, until recently electrical engineer to the Corporation, was the first witness called for the promoters. The Corporation, he said, already supplied power to Balby-with-Hexthorpe, Wheatly and Carhouse, for tramway purposes. The works belonging to the Corporation were constructed in the year 1899, the order having been obtained in 1898. When first started the works had a capacity of 188 kw., which had now been increased to 920 kw. Their buildings were large enough for extensions for some time to come. The plant could be increased to supply 2,000 kw. From time to time they had received applications to supply surrounding districts. Balby obtained their order authorising them to take a supply in 1901. In the district of Wheatly there were many houses that were already wired to receive a supply. In his opinion the Yorkshire Electric Supply Co. had made no effort to supply the neighbourhood. It was true that the company were erecting a generating station, but it was 30 miles away from Doncaster, at Thornhill.

Cross-examined by Mr. Freeman, K.C. (for the Supply Co.): He was aware that in 1901 the Yorkshire Electric Supply Co. sought the district, and were opposed by the local authorities. The result was that Doncaster was excluded. He admitted that there was no suggestion then that Doncaster should supply outside districts. The area of the districts now proposed to be supplied was 26,000 acres. He was not aware that one of the stations of the company was completed, or that large contracts had been entered into for the supply of cable.

Mr. Freeman: Do you, as an engineer, assert that there would be any difficulty in supplying from that station. Witness: No; but it would be an advantage to have the station nearer. He did not know of any case where a corporation had been allowed to go outside its own district and compete with a company.

Mr. Page (for the Corporation): And you do not consider that the Yorkshire Power Co. is in possession of this district? Witness: No.

Mr. Frederick Nicholson, solicitor to the promoters, said that the present supply was chiefly for light; there was considerable colliery development going on in the district.

Mr. T. Gill, a builder and contractor, said that he had erected and owned a large number of villa residences in the Wheatly district, and they would all take a supply. In fact, there were many houses ready to take the light at once. He hoped to see the Corporation get power to supply at once. Part of the main road between Wheatly and Doncaster was in Wheatly, and part of it was in Doncaster, and it was most inconvenient that the Corporation should have power to supply one side and not the other.

Mr. G. Gledhill, surveyor to the Balby-with-Hexthorpe R.D.C., spoke of a similar position in regard to the main road between that Rural District and Doncaster. His Council were in favour of the Corporation having the powers asked for. He knew that there were many factories which would take a supply of current at once, if they could get it.

Mr. Mark Dunstan, the chairman of the Electric Lighting Committee of the Corporation since its formation, said that they had now turned the corner, and were making a profit. He believed they could supply the proposed increased area without increasing their capital charges. This concluded the case for the promoters.

Mr. Freeman then called Mr. G. Lupton, the chairman of the Yorkshire Electric Power Co., who submitted photographs for the inspection of the Committee, showing the advancement of the works at Thornhill. Those works, he said, were being pushed forward as quickly as possible. They would be in a position to supply in the autumn of this year. There were three other generating stations to be erected, and they would be erected as soon as possible when the demand increased. The contracts included the erection of the second station. There was no ground for the suggestion that they did not wish to go to Doncaster. They resented the action of the local authorities in getting hold of the best part of the area. They did not wish to have the competition of a rate-aided business. At the present time they had contracts for the supply of energy to collieries.

Cross-examined by Mr. Page: The nearest consumer of energy with whom they had a contract was some distance from Doncaster. It would not be good policy to go on with the other three stations at one time. The company had no immediate intention of erecting the station at Hardwicke. He was aware that if the Bill passed and the Corporation were allowed to supply without their district the company would still be able to compete with them.

Mr. Freeman then shortly addressed the Committee on the petition.

This was the first time that such powers had been sought in Parliament. If all Corporations sought similar powers what would be the result? It was, he contended, not competition in the ordinary sense, for the Corporation had the rates behind them. The Act did not intend that a Corporation should go marauding in outside districts; it was intended that local authorities should be able to apply themselves for provisional orders to receive supplies. If the Corporation succeeded in getting the powers it would be the first time that such a thing had been done, although several attempts had been made, but had been refused by Committees. Either the clause giving the power had been struck out or it had been allowed to remain with the sanction of the company. He asked the Committee not to take from them a district they were perfectly willing to supply.

Mr. Page, in replying for the Corporation, said that they were asking for no more power than a local authority could obtain by provisional order, if they chose to apply for one.

After consultation the Committee refused the Corporation the powers sought with regard to the supply of electricity.

Dewsbury, Soothill Nether, and Ossett Tramways.

The Bill promoted by the Urban District Council of Soothill Nether, Yorks, came before a Select Committee of the House of Lords, Lord Hawkesbury presiding, last week.

Board of Trade provisional order Bills for the confirmation of orders authorising the construction of tramways by the Corporations of Dewsbury and Ossett were considered at the same time, as the three systems would provide a through route from Dewsbury to Ossett.

The case for the promoters of the Soothill Nether Bill was opened by Mr. Wedderburn, K.C. He said that the inhabitants of the district were in favour of the scheme, and there was no property likely to be injured by the tramways. Coming to a consideration of the provisional orders, Counsel said the Board of Trade had granted them after very careful consideration. There was a great public need for the tramways in Dewsbury, and if they and the lines in Ossett were authorised, they would provide a through route from Dewsbury to Ossett. Then there was the authorised tramway of the Wakefield District Light Railway Co., which passed through a place called Horbury to Wakefield; by means of a connection with that line there would be a through route from

Dewsbury to Wakefield. The scheme was opposed by the Great Northern Railway Co. on the ground that the through route would compete with their railway.

Mr. J. H. Rhodes, the engineer to the scheme, described the route, and stated that the trams would be worked on the overhead trolley system. The gauge would be 4 ft. 8½ in, and the rails of 102 lbs. to the yard. Altogether the length of the route would be 2 miles 3 furlongs. The Parliamentary estimates, as stated in the preamble of the Bill, amounted to £39,945.

Mr. J. E. Waller also gave evidence.

Mr. Claude Baggallay having addressed the Committee for Ossett,

Mr. Balfour Browne called

Mr. Bury, the general manager of the Great Northern Railway Co., who said that as proposed, the tramways would certainly compete with his line. He objected to a through connection being established, but he would not object to any of the tramways provided that there was no connection between them.

The Committee having consulted, found the preamble of the Soothill Nether Bill proved, and confirmed the Dewsbury and Ossett orders.

When clauses were considered on Monday, the Committee granted the Yorkshire Electric Power Co. a clause providing that the Corporations of Dewsbury and Ossett should not supply energy in the district of a statutory authority, without the consent of such authority.

Sunderland District Electric Lighting.—On June 16th, before a Select Committee of the House of Lords, presided over by the Duke of Northumberland, a number of Electric Lighting Orders came up for consideration. Mr. Balfour Browne, K.C., appeared for the County of Durham Electric Power Co., who asked for the confirmation of the Board of Trade order for the supply of electricity in certain districts about Sunderland. He said that the Sunderland Corporation did not appear before the Board of Trade, but they had presented a petition against the order on the ground that the company were asking to supply districts which, in years to come, might be included in the Corporation area. Now he found that the Corporation made no appearance, but he had received no notice of their intention to withdraw the opposition, and consequently he had been put to the expense of bringing his witnesses from the district. Under the circumstances he asked that he should be allowed costs against the Corporation. The Committee having consulted together, the Chairman announced that they had unanimously decided to allow costs against the Corporation. The order was confirmed.

Shipley Urban District Council Bill.—On Friday this Omnibus Bill came before the Chairman of Ways and Means of the House of Commons as an unopposed measure. The Bill, amongst other things, gives the Council power to lay down electric mains and wires in private streets, and also power to supply electric energy in certain parts of Baildon.—The preamble of the Bill was declared to be proved.

Lancashire Electric Power Bill.—On Friday the Lancashire Electric Power Bill came before the Committee of the House of Commons, presided over by the Chairman of Ways and Means. The object of the Bill is to remove the restrictions relative to the erection of generating stations only on lands scheduled in the company's Act of 1900; it authorises the company to take over electric light provisional orders from local authorities and others, and enables interest to be paid out of capital during construction. Further, it allows the company to pay a commission not exceeding 5 per cent. to any person in consideration of his subscribing or procuring subscriptions for any shares in the company. Mr. Frere appeared for the promoters. With regard to the extension of time, the reason they had to ask indulgence was that the company was one of the pioneer companies which came out at the time of the war, and, consequently, had been able to do little. Now they had commenced, and hoped by 1905 to be in a position to supply. The chairman asked what amount of capital had been raised. Mr. Frere said £400,000 had been raised, but the authorised capital was £3,000,000. The company, however, had a large district, and would commence in one area first, and might not require all its capital for some years. Mr. F. E. Gripper was called, and stated that the roof of the generating station at Ratcliffe was nearly on. The Committee passed the preamble of the Bill.

Leicestershire and Warwickshire Electric Power Bill.—This Bill came on Friday before Mr. W. H. Lowther's Committee of the House of Commons. The object of the Bill is to amend certain sections of the company's Act of 1902 by extending the time for commencing works and providing generating stations for a further period of two years. It also gives the company power to erect generating stations on lands other than those scheduled in the Act, and to acquire electric lighting provisional orders from local authorities or other persons by agreement. Mr. Bell, who appeared for the promoters, in reply to the Chairman, said the company was now commencing its works. The capital was £750,000, but before it could supply it had to obtain a certificate from the Board of Trade that £200,000 had been subscribed. Mr. Ashcroft was called to prove the preamble, and stated that the works were now well in hand. The Committee passed the preamble of the Bill.

Saddleworth and Springhead Tramways (Abandonment) Bill.—The Standing Orders Committee of the House of Commons has decided that standing orders may be dispensed with in the case of the above Bill, and that if the Committee considering the Bill think fit, the promoters may be allowed to introduce their additional provision asked for. This provision provides for the abandonment of certain authorised lines and the reduction of capital.

Clyde Valley Electrical Power Bill.—The opposition of the Lanark County Council to this Bill has been withdrawn.

Leyton Urban District Council Bill.—In his report to the House of Commons as Chairman of the Committee which considered the Leyton U.D.C. Bill, Mr. Heywood Johnstone states that the Bill authorises the Council to construct and maintain tramways beyond their district, viz., in the County Borough of West Ham and the urban district of Walthamstow, but such tramways will be in connection with the tramways authorised to be constructed by the Council within their district, and the Committee are of opinion that having regard to the special local circumstances, such construction ought to be allowed. The length of the tramways to be situate beyond the district is 4 furlongs 9·5 chains.

Metropolitan District Railway Bill.—The Standing Orders Committee of the House of Commons has refused to suspend the Standing Orders to allow the Chiswick U.D.C. to oppose the above Bill.

West Riding Tramways Bill.—The Midland Railway Co. have withdrawn their opposition to this Bill.

Petitions.—The following petitions in opposition to Private Bills have been deposited in the Private Bill Office of the House of Lords:—To the London United Tramways, by the South-West Suburban Water Co.; to the Middlesbrough, Stockton-on-Tees, and Thornaby Tramways, by the Linthorpe Parish Council and the Middlesbrough Estate, Ltd.; to the Radcliffe Tramways, by the Whitefield U.D.C.; by the Manchester, South Junction, and Altrincham Railway Co. against the confirmation of a tramway order to the Altrincham U.D.C. in the Tramways Confirmation Order Bill No. 1. The Hampton Wick U.D.C. is objecting to the confirmation of the Hampton Wick and District Order in the Electric Lighting Provisional Order No. 6.

LEGAL.

Siemens Bros. & Co., Ltd., *v.* Patent Exploitation, Ltd., and Another.

In the House of Lords on Tuesday, Lord Macnaghten (presiding), and Lords Davey, James of Hereford, and Robertson gave judgement in the above case, which was argued in May, when judgement was reserved. The appellants, Siemens Bros. & Co., appealed from an order of the Court of Appeal reversing a judgement of Mr. Justice Buckley. The action was brought by the respondents to restrain an alleged infringement of letters patent, No. 1,110 of the year 1890, granted to one Charles Addison Hitchcock, who had assigned his rights to them, for an invention of "an improvement in galvanic batteries," and they asked by their statement of claim for "damages or an account of profits, delivery up and costs." Mr. Justice Buckley held that the letters patent were invalid, upon the ground that there was no novelty in the invention, and that the claim made was too wide. The Court of Appeal, on the amended claim held that the patent was valid and that there had been infringement. They accordingly discharged the order made by Mr. Justice Buckley, and granted an injunction with the relief asked for. Hence the appeal to their Lordships' House, in which it was seriously denied by the appellants that there had been an infringement of the respondents' letters patents by the way they had constructed their dry batteries, but they submitted that the alleged patent was bad for want of novelty, and they asked, therefore, that the judgement of Mr. Justice Buckley should be restored. After the trial it was resolved by the respondent company to go into voluntary liquidation, and in September, 1903, under the sanction of the Liverpool District Registrar, the voluntary winding up of the company was continued, and Mr. J. M. Wade was appointed liquidator, and that gentleman was added as a respondent in these proceedings before their Lordships' Bar.

Mr. Fletcher Moulton, K.C., and Mr. A. J. Walters (instructed by Budd, Johnsons & Jecks) appeared for the appellants; Mr. Astbury, K.C., and Mr. A. B. Shaw (instructed by James, Mellor & Coleman) for the respondent company and the liquidator.

It was stated during the argument that a number of similar actions against other companies which had been commenced by the respondents were by consent standing over pending the decision of their Lordships in this case.

Lord Macnaghten, in moving that the appeal should be dismissed, said he had come to the conclusion that the view taken by the Court of Appeal was right, and should be affirmed.

Lord Davey thought that for the purposes of this appeal it must be taken that the appellants' battery, both in construction and materials, was substantially identical with that of the respondents. The evidence on this subject was meagre but sufficient, and he need not refer to it at length. Whatever, therefore, was the construction of the specification, it did not affect the question of infringement, and was only material in considering the question of the validity of the respondents' patent. The objection made by the appellants to the validity of the patent was that the specification did not point out with sufficient clearness what the real novelty and merit of the alleged invention consisted in, and that the claim was expressed in such wide and vague words as to embrace forms of galvanic batteries which were well known and in use at the date of the letters patent. The patentee, they said, might have invented an improvement in the construction of galvanic batteries; but if so, he had not adequately described the

nature of it, as required by law, and had claimed a great deal that he never invented. Now, the elements of a galvanic battery were well known. You must have your two electrodes, normally of zinc and carbon; you must have your excitant, which must be a liquid or contain liquid; and you must have your depolarising agent to prevent the formation of a film on the carbon, which would not spill and which was at once portable, capable of being stored in a shop or warehouse for sale, and of retaining its efficiency for a sufficiently long period whether at work or not. The respondents' patent was for a combination in a new manner of the well-known elements already mentioned. In such a patent there was no room for the common objection that the patentee had not sufficiently distinguished the old from the new, for, as Lord Cairns pointed out in Harrison *v.* Anderton Foundry Co. (1 Appeal Cases 574, at page 578) the combination itself constituted the novelty and merit of the invention. It was sufficient for the validity of the patent if the combination, being the result of thought or experience, was new and produced some new result, or an old result in a more useful or beneficial way. The patent was for "an improvement in galvanic batteries." The specification was commendably short, clear, and intelligible. The patentee described a cylinder of zinc or other equivalent metal forming the one electrode, which was lined with an exciting agent consisting preferably of certain ingredients of a well-known description. "For preparing the exciting agents," he said, "the materials are mixed, forming a semi-fluid which is poured into the cylinder around a central core temporarily inserted. The exciting agent soon sets to the condition of a semi-solid, and the temporary core is removed." The carbon was then inserted, and the space round it was filled with a compound consisting preferably of the following ingredients:—Sal-ammoniac, 1 part; chloride of zinc or other hygroscopic analogue, $\frac{1}{10}$th part; and, as depolarising agents, pulverised peroxide of manganese, 8 parts, with pulverised carbon, 3½ parts. These were mixed with water, 2 parts, to form a semi-solid, which was packed in round the carbon. The top of the cylinder was then sealed. The specification concludes with the following:—

"The materials mentioned as electrodes, and as exciting and depolarising agents, and their proportions, may be varied, as the important feature of the invention is the interposition between the positive and negative electrodes of two layers of exciting composition in a semi-solid or plastic state, the one in contact with the negative electrodes having intermixed with it depolarising agents, and the one in contact with the positive electrode having no such depolarising agents in its composition." The claim was for "a galvanic battery having the space between its positive and negative electrodes filled with a semi-solid or plastic exciting agent in two layers, the one layer in contact with the negative electrode have depolarising agents intermixed therewith, and the other layer in contact with the positive electrode having no such depolarising agent substantially as set forth."

It was contended by the respondents that the use of peroxide of manganese, or other depolarising agent in the form of powder, was one of the elements of the combination, and a large part of the evidence and argument was taken up in the discussion of the difference between pounded and a pulverised material. The noble Lord thought it was not necessary to embark on that interesting inquiry, or to say whether it was more than a question of degree. He agreed with Mr. Justice Buckley and Lord Justice Cozens-Hardy, differing from Lord Justice Vaughan Williams, and, presumably, from Lord Justice Stirling, that the patentee had not made the use of the material in a pulverised form a necessary element in the combination which he had claimed, or, in other words, if that was his real invention, he had not claimed it. He thought that it was not necessary to decide it in the present case, that the words "substantially as set forth" would cover the use of materials analogous to, or having similar chemical or electrical properties to, those which he had described as preferable, and the recommendation of pulverising materials might be useful as illustrating the sort of thing he intended by the word "plastic." He did not himself construe the words "semi-solid or plastic" as alternatives, for they were not true alternatives, but he thought that the word "plastic" was meant to be synonymous with, and explanatory of, "semi-solid," and was used with the intention of giving some definiteness to a somewhat vague expression. The patented battery, their Lordships had been told, had achieved a great commercial success. Mr. Gore, an electrical engineer in the service of the National Telephone Co., stated that up to the time when the respondents' battery was introduced to his company, they had only experimentally used any dry batteries. He mentioned the Gassner and the Hellesen, which were two of the batteries relied on by the appellants as anticipations. He said it was found that these batteries had not a long life compared with the patented battery. "If they were used immediately, they were a very good cell, but if kept in stock for any time they deteriorated . . . . ." Mr. Gore's company had bought considerably over 120,000 of the respondents' batteries, and had also in recent years used the appellants' battery, which they found equally efficient. It was remarkable that neither of the very eminent electricians who gave evidence could say with certainty to what particular cause the success of the patented battery was attributable. Mr. Swinburne was disposed to attribute it to the use of the depolarising agent in a pulverised form, which to him was a novel idea. It was unnecessary for their Lordships to form any opinion on this question, though if the issue were whether an alleged infringer had taken the substance of the patented invention it would be different. The present came within the category of infringers described in Lord Cairns' well-known judgement in Clarke *v.* Adie, 2 App. cas. 215, at p. 220. He thought that the evidence given by Mr. Gore and other witnesses established that the respondents' combination did produce a known result in a more useful and beneficial way. The establishment of this point had a material bearing on the question of subject matter. No instance was produced of any previous battery coming within the exact description of the patentee's claim. There was no doubt on the evidence that the exciting agent (solution of sal-ammoniac) would diffuse itself over the whole mass within the jar, but he hesitated to say that the direction for the two layers both containing an exciting agent had no significance. The absence of a linen bag or other diaphragm to hold up the depolarising agent had been proved to be unimportant, except as an explanation of what the patentee meant by "semi-solid or plastic." The maintenance of the two layers in that condition was the important element in the combination by which the validity of the patent must be tested. The two previous specifications which came nearest the description of the patentee were those of Thiébaut, dated April 26th, 1881, with an addition dated August 16th, 1881, and the English patent of Castle Smith, of 1889. In the amended form of Thiébaut's specification, the contents of the battery are in two layers, but the outer layer is solid, and as the patentee says, a hammer has to be used to destroy it. Castle Smith patent is a communication from abroad of a Dane named Hellesen. Superficially and substantially, it was very close to the respondents'. In one respect it was more complete, in that it contained an elaborate provision for the escape of the gas which was inevitably formed. The omission of such a provision, however, was not made a point of against the respondents' patent, probably because every workman would know that he must make a vent hole. The noble lord then dealt with the specification of Castle Smith battery, and said that the phlegmy or jelly depolarising substance might possibly be described as a semi-solid one, but could by no fair use of language be called plastic. It was not a question of degree, but a difference of kind. Thiébaut's patent was at best a mere paper anticipation. He had no doubt that Mr. Ballantyne's ability enabled him to make a workable battery out of it, but there was no proof of a battery made in accordance with Thiébaut's directions having been sold or used. The Hellesen battery, on the contrary, was on the market, and, as he had mentioned, was compared unfavourably with the respondents' battery by Mr. Gore. It was not, however, proved that the Hellesen batteries in use were made in strict accordance with Castle Smith's specification, and the appellants, although they included the prior use of the Hellesen battery in their particulars of objection, did not pursue the subject. For himself he disclaimed putting either a benevolent or malevolent interpretation on the specification, or being astute either to uphold or invalidate the patent. In his opinion, a specification, like any other document, should be construed by the Court according to the fair meaning of the language used, after being informed by evidence of the nature of the subject matter, the state of knowledge at the date of the patent, and the meaning of any scientific or technical words that were found in it. In his Lordship's opinion, this appeal might be summed up in a single sentence. He found that the patentee had described and claimed as his invention a galvanic battery, in language which was not anticipated by, and did not in terms cover or include, any previous description, or any battery previously known or described, and his battery was proved to have produced useful and beneficial results; and, lastly, he must hold, on the evidence in this case, that the appellants had taken his battery in its entirety. It might be that the invention was a small one, but slight differences in these cases sometimes produced large results. He adopted the words of Sir George Jessell in Hinks *v.* Safety Lighting Co., 4 Ch. D. 601, at page 615, "Where a slight alteration in a combination turns that which was practically useless before into that which is very useful and very important, judges have considered that though the invention was small yet the result was so great as fairly to be the subject of a patent, and so far as a rough test goes, I know of no better." On the evidence before their Lordships he was of opinion that the respondents' patent was a valid one and that the appeal failed.

Lord James of Hereford and Lord Robertson concurred.

The appeal was accordingly dismissed with costs.

Bright's Light & Power Co., Ltd.

Mr. Justice Farwell, in the Chancery Division of the High Court on Tuesday, heard the action of Owles *v.* the River Plate Electricity Co.

Counsel stated that it was a motion for judgement against Bright's Light and Power Co., Ltd., in default of defence. The defendants, the River Plate Electricity Co., were prior mortgagees, and the action against them had been dismissed. The statement of claim alleged the issue of a debenture for £2,000 to the plaintiff, and charged the leasehold property of the company, and all its concessions and plant, both in England and elsewhere, including the uncalled capital. Plaintiff asked for judgement in the form of the minutes submitted, and a declaration that he was entitled to the charge above named.

His Lordship granted the usual mortgagee's judgement, and asked whether counsel would take a foreclosure decree or an order for sale. Counsel asked for the latter. Order accordingly.

Lyles *v.* Southend Corporation.

In the King's Bench Division of the High Court of Justice on Tuesday, before Mr. Justice Bigham, sitting to try special cases, the action of Lyles *v.* the Mayor and Corporation of Southend came on for hearing. From the facts, as stated, it appears that the plaintiff, Mr. Thomas Lyles, a City business man, was, on August

9th, 1903, travelling by the defendant Corporation's electrical tramways from Southend to Leigh and back. He was an outside passenger, and on the return journey the connecting rod, which reached from the roof of the car to the electric wire overhead broke, and a part of the rod, in falling, struck plaintiff, severely injuring him. He suffered from shock, and as he was unable to attend to his business for seven months, he claimed about £400 damages for loss of income and medical expenses. For the defendant Corporation it was submitted that the accident was not due to any negligence on the part of their servants; and they also said that the claim was barred by reason of Sec. 1 of the Public Authorities Protection Act, 1893, which provided that such claims should be brought within six months. That had not been done in this case. After hearing lengthy legal arguments by Mr. S. T. Evans, K.C., for the plaintiff, and by Mr. English Harrison, K.C., for the defendants, his Lordship ruled that the case came under the section of the Act in question, and dismissed the action with costs.

National Electrical Construction Co. *v.* Rathmines and Rathgar U.D.C.

On 16th inst., Mr. Justice Gibson (without a jury) heard this case at Dublin. Plaintiffs sued defendants for damages and for rental of certain electrical fittings which, under a contract of May 17th, 1889, with the defendants, they had put into the houses of consumers of electric light. The agreement provided that for every unit of electricity sold by the defendants to consumers they should pay the plaintiffs 1d. a unit, and they were also, in case of consumers who did not take the minimum quantity, to pay a sum to the plaintiffs that would give them 1s. per lamp. The defence was that all the money due had been paid over.

The case was adjourned with a view to a settlement.

Chepstow Electric Light and Power Co. Summoned.

At Chepstow Police Court recently the Chepstow Gas and Coke Consumers' Co., Ltd., summoned the Chepstow Electric Light and Power Co., Ltd., for that on September 7th and November 13th, 1903, at Chepstow they made default in complying with a certain requirement of Sec. 18, Sub-Sec. 1, of the Electric Lighting (Clauses) Act, 1899, in that the Electric Light Co. did not give to the Gas Co. not less than three days' notice before commencing to dig or sink trenches for the purpose of laying down and constructing new electric lines and other works near to the mains or pipes or other works belonging to the Gas Co. According to the *Western Mail*, the Chairman said the Court were of opinion that the Gas Co. had made out a case, and they decided, therefore, in their favour. They thought the Gas Co. justified in coming to that Court, as it was their only method of obtaining a judgement. They imposed a penalty of £1, with a daily penalty of £1., the costs of the Court to follow the decision.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Continuous Current v. Single-phase for Traction.

I notice that your issues of April 29th and May 6th of this year contain an article by Mr. H. M. Hobart, entitled "The Continuous Current System and the Single-phase System for Traction." This article contains in general :—

1. A criticism of the single-phase system for traction, and

2. A parallel between such a system and a continuous current system of high voltage.

The first part of his paper contains, to a considerable extent, criticisms of the paper which was read by me before the Canadian Society of Civil Engineers, November 19th, 1903, and the second part contains a parallel comparison between my estimates as given in that paper and his estimates on a proposed 1,300-volt D.C. system to cover the same conditions. In view of the fact that Mr. Hobart's article is to a considerable extent a criticism on my paper, I beg that you will grant me the use of your columns to submit the following in answer to the points made by Mr. Hobart in the article above referred to.

In order to answer Mr. Hobart's criticisms more thoroughly, I will quote the specific objections which Mr. Hobart makes to the estimates made in my paper above referred to, and then will give my answers to the specific points which he mentions.

1. "That he overlooks the fact that single-phase generators cost some 30 per cent. more than polyphase generators for the same rating and guarantees."

It is only in an exceptional case that it is necessary to use the single-phase generator in the A.C. system. It is true that single-phase currents are used, but these single-phase currents may be taken as well from a two-phase generator as from a single-phase generator. As a matter of fact, the estimates in my Canadian Society of Civil Engineers' paper were based upon using a two-phase generator, although inadvertently it is referred to in the text of my paper as being a single-phase generator. The objection, therefore, that single-phase generators are more expensive than polyphase generators does not apply to the typical case.

2. "That he overlooks the increased cost of low periodicity transformers."

The costs of transformers as given in my paper are fair, as they are the prices that would have been quoted to actual customers. The estimates are also in proportion to relative costs. Variation in size affects the cost of transformers per kilowatt considerably more than does a proportionate variation in frequency.

3. "That there is no reason to employ many small and expensive single-phase transformers for the polyphase central and sub-stations. It is only in America that this has been customary, and now large polyphase transformers are being substituted for groups of single-phase transformers in America also."

It is self evident that more transformers must be used on the three-phase than on the single-phase system, and it is only by the expedient of adopting polyphase transformers on the one hand, as against single-phase transformers on the other, that the number of transformers in the two systems estimated upon in my Canadian Society of Civil Engineers' paper could have been made the same. The advantage of the polyphase transformer as against the use of a number of single-phase transformers, to make up the same equivalent, is by no means a proven proposition. It is well known that for a given aggregate output, a single-phase transformer is cheaper than a three-phase transformer.

4. "That the single-phase generating plant is not sufficiently liberally proportioned, in view of the poor average power factor."

In regard to the point that the generating plant is not sufficiently liberally proportioned, I would answer that in my estimates the proportionate amount of power at the power house for the A.C. system was greater than that provided for the D.C. system, so that in the comparison the advantage is certainly not in favour of the A.C. system. It must be remembered that the efficiency of the A.C. system is considerably greater than the D.C. system.

5. "That since the chief handicap of the continuous current system is, as Mr. Lincoln has pointed out, the low tension conducting system, the voltage should have been increased, as this is a perfectly sound proposition in the present state of the art; much more sound than some of the features of the single-phase system he describes."

In the matter of the desirability of increasing trolley voltage, Mr. Hobart and myself are in perfect agreement. This is apparently not a criticism, but a statement of opinion in which Mr. Hobart and myself agree.

6. "Large transformers are artificially cooled, and some attendance, such as very frequent patrolling, is advisable for the sub-stations, even with the single-phase system."

Transformers of a size proposed in my paper would not require artificial cooling. The limit of size for self-cooled transformers includes those up to 500 KW., and this size will take care of a single-phase railway proposition of considerably larger dimensions than the one assumed in my paper. With properly designed and installed automatic devices, there is no reason why a transformer station cannot take care of itself and cut out only when something unusual occurs, such as the breaking of the trolley wire or the short-circuiting of the transformer itself. Under these conditions an attendant would be helpless, even if he were present. He would have to await the arrival of the break-down gang. With the A.C. system, the duties of the break-down gang would be not only to effect repairs, but also to see that automatic devices for the transformer stations were again replaced and the service of power from the station resumed.

7. "The high voltage per turn in the field spools of the alternating current system, the less satisfactory commutation, and the more complex auxiliary apparatus will inevit-

ably result in a higher percentage depreciation than for the continuous current equipment. Nevertheless, Mr. Lincoln takes 10 per cent. for the former and 12 per cent. for the latter."

In my paper, I took as a depreciation account on the equipments 12 per cent. for the D.C. and 10 per cent. for the A.C., and particularly called attention to the fact that this percentage gave $10,000 a year for keeping up the A.C. equipments as against $7,500 a year for keeping up the D.C. equipment. In view of the much lower voltage on the A.C. equipments, and their freedom from direct lightning discharges, due to the presence of the car transformer, it is my belief that the figures for maintenance of car equipments as given in my paper are certainly not unfair to the D.C. system.

Although the estimates of cost, &c., contained in my paper before the Canadian Society of Civil Engineers fitted the conditions which existed at that time, the figures therein given are already out of date, due to the rapid advances which the single-phase system has made within the last year. The estimates in that paper were based upon the apparatus which had already been completed and was ready for delivery at the date of writing. Since then marked improvements have been made in single-phase equipments. These improvements are in the direction of considerably decreased weight and cost. An equipped car of the newer type of apparatus, instead of weighing 18 per cent. more than a car equipped with equivalent D.C. apparatus, would to-day weigh only about 5 per cent. more. The cost of such an equipment, too, instead of being approximately 40 per cent. more than an equivalent D.C. equipment, as assumed in my previous paper, would now be but about 25 per cent. more. The frequency for the standard equipment also has been increased from 2,000 alternations per minute to 3,000. This change brings the standard frequency for single railways to match that in general use for power distribution. These improvements therefore mean not only reduced cost of car equipments themselves, but also a reduced cost in secondary distribution, transformer stations, high tension line and power house. The cost of the A.C. system to-day would be at least 10 per cent. less than that figured in the paper which Mr. Hobart criticises, and would therefore be well below the cost of the high voltage D.C. system upon which Mr. Hobart has given estimates.

Now we will take up for critical examination the system which Mr. Hobart proposes to use in place of the A.C. system. This, in general, consists of a D.C. trolley voltage of 1,300, and the use of this voltage across two 650-volt motors permanently in series in the equipments. Granting for the moment that such a system is sound from an engineering point of view, the detail figures as given by Mr. Hobart will, I believe, bear some modification, although in general they seem to present a fair comparison.

In calculating his line losses, Mr. Hobart has used the average current which will be delivered by his power station and not the square root of the mean square current, as was used in my determination of line losses. It is evident that the line losses depend not upon the average, but upon the square root of mean square, which is invariably greater than the average.

The figures on cost for 1,300-volt generators as well as the increased cost of motors due to necessary additional insulation are not sufficiently provided for in Mr. Hobart's estimates. The item for both generators and motors will, I believe, have to be somewhat increased before the comparison is perfectly fair.

It is not to Mr. Hobart's presentation of this system, however, that the principal objection lies, but rather to the system itself. We cannot grant that the system proposed by Mr. Hobart is sound engineering.

The general scheme of two 650-volt series motors in series on 1,300 volts, besides being subject to a number of other objections, is open to the fatal one that, under certain conditions, practically all the voltage may be thrown across one of the motors. Probably nearly every one who is familiar with electric traction matters has observed the action of a car equipped with a series-parallel controller starting on a slippery track; at least, I have observed it time and time again, particularly on snowy track. The action referred to is the spinning around of one pair of wheels—usually the forward pair—at the instant of starting or when running slowly and while the controller is still in the series position. I have many times seen a car refuse to start until the controller reached the parallel position. The explanation is simple. It is due to the fact that the coefficient of friction is considerably greater before than after the wheels have started to slip. Under this condition of one pair of wheels spinning, it is evident that practically the entire line voltage is taken up across the spinning motor. With two 650-volt motors in series on 650 volts this condition simply means normal voltage across one motor. But with two 650-volt motors in series across 1,300 volts, it means double voltage across one motor, a condition that means disaster to the motor not only on account of increased insulation strains, but also on account of the run-away speed that must necessarily follow doubling the voltage.

Although this objection is, to my mind, controlling, it is not the only one that obtains against this system. Among others may be mentioned:—

1. Rheostatic loss must necessarily be greater. In Mr. Hobart's case this rheostatic loss amounts in a 2-mile run to 16 per cent. of the power used. This evidently is a severe handicap in itself.

2. Insulation of the motors must be made to withstand at least double the standard voltage of to-day. This higher voltage strain means not only a considerably increased cost of motor, but also increased liability to damage. In the A.C. system the high voltage does not go beyond the transformer, and the ease of insulating a transformer compared to insulating a motor, is evidently a decided advantage which must necessarily be possessed by the A.C. system.

3. One of the most serious difficulties with the D.C. motor of to-day, particularly the larger sizes and higher voltages, is that of flashing, under certain conditions, from brush to brush on the commutator, or from brush to ground. This danger of flashing with double voltage must necessarily be not only increased, but the consequences when a flash is taking place will be much more severe.

In conclusion, I may call attention again to the point of agreement between Mr. Hobart and myself, viz, the desirability of increasing trolley voltages. For heavy work, this desirability becomes practically a necessity. With alternating currents the trolley voltage limit is absolutely removed; it may be made anything within the limits of trolley line insulation. With direct currents, on the other hand, the considerations enumerated above set a limit at a point not far above the maximum at present in use. One of the strongest answers that can be urged to Mr. Hobart's proposition to double the trolley voltage and put two motors in series, is, that it has been recognised for years as a partial answer to the traction problem, that it has been proposed again and again, but, in spite of that, it has not been put into commercial operation in a single instance, so far as I can discover. The same statement holds true for the modified form of Mr. Hobart's proposition, viz., the use of the three-wire, neutral grounded system for electric traction. This system, although it avoids some of the objections to increased trolley voltage, introduces others which have, up to the present, prevented its practical adoption. To the necessity for higher trolley voltages the A.C. system is the perfect answer, while any D.C. system must necessarily partake more or less of the character of a makeshift.

P. M. Lincoln.

Pittsburg, Pa., *May 31st*, 1904.

Inter-urban electric traction work is, in my opinion, the peculiar field for the alternating current system. . . . . When stops are few and consequently runs are long . . . . the advantage of the alternating current system is not so marked. With short runs, on the other hand, and consequently frequent starts . . . . the alternating current system can have the greater advantage.—Lincoln, *Electrical World and Engineer*, December 12th, 1903.

It thus appears that, while suburban work was once thought to be the most important field for the single-phase railway, it has now become evident that city work, where traffic is very congested in parts of the system, will prove to be one of the best fields for this system.—Lamme, *Electrical World and Engineer*, December 26th, 1903.

To such advocacy of single-phase traction for other than heavy traction work, I took exception in the articles to which Mr. Lincoln's letter refers, and I contended that the

time had arrived for raising the distribution voltage in continuous-current traction work. I consider that the arguments by which I supported this contention were sound, and that the results arrived at by my illustrative example were convincing.

Nor does Mr. Lincoln appear prepared to contest the desirability of raising the voltage in continuous current traction systems. His criticisms are chiefly directed against the particular system which I employed in my illustrative example, in the choice of which I was largely influenced by a desire to take a case susceptible to ready analysis, and because the equipment did not exceed the limits of present practice as to the permissible electromotive force at the motors. I consider this system as by no means the ideal equivalent continuous current system, but as one on which standard equipments could be used, and still give results comparing favourably with those obtained on the most modern single-phase systems of which results are as yet available.

There are many ways of meeting the possible difficulty referred to by Mr. Lincoln respecting the spinning of the motors, either by the use of double-commutator motors or of component motors designed for a working pressure of 1,300 volts. On the other hand, I consider that in adhering to the system of two 650-volt motors permanently connected in series, since these motors would in ordinary practice be built to withstand a 4,000-volt test, there is ample insulation to take care of any possible abnormal voltages to which they would be subjected. The contingency of a motor's attaining "runaway speed" with the car-wheels grinding on the track appears to me to be rather remote. Present series-parallel control systems suitably re-proportioned, would most certainly now be practicable at double the present standard voltage, and ultimately much higher; 100 per cent. increase of the present standard voltage of 650, up to 1,300 volts would, however, suffice to greatly extend the range of economic operation with the continuous-current series-parallel system, and it would rarely be necessary to employ still higher voltages. The heaviest express trains are to be hauled on the New York Central at speeds up to 75 miles per hour at a distribution voltage of but 600.

High-voltage continuous-current motors are by no means the untried novelty which Mr. Lincoln assumes. Thus, on p. 185 of vol. 33 of the *Journal of the Institution of Electrical Engineers*, Mr. Patchell states:—

"I have not had a 1,000-volt motor on tramcars, but I have been running 40 200-H.P. motors on 1,000 volts for several years past, and the breakdowns have been comparatively nothing; I do not suppose we have had half a dozen burnt-out armatures in that time."

Scattered about England and the Continent, are several other instances of high-voltage continuous-current working. For mechanical purposes the insulation must in any case be of such thickness that but little additional space is required for insulation when suitable material is chosen, when the voltage is raised from 650 to 1,300 volts. The commutation is not rendered inferior in virtue of the increased voltage, so long as the speed for a given output remains moderate. An ever increasing percentage of traction work nowadays requires motors of from 50-H.P. to 200-H.P. capacity each, and at speeds of from 300 to 600 r.p.m. These speeds are distinctly moderate for 1,300-volt commutation at these outputs; indeed, the commutation may, with correct design, be fully the equal of the commutation of 25 to 35-H.P. tramway motors at 650 volts, the greater size of the former offsetting their higher voltage. The commutator for the higher voltage becomes somewhat shorter, the brush friction and C^2R losses are reduced, and so far as the commutator is concerned, the motor is cheaper and more efficient. This gain is no more than offset by any sacrifices in the remainder of the design. Coming to the question of the continuous-current generators at the power house or sub-stations, an increased outlay is incurred, since the high-voltage continuous-current generator of large size should most decidedly be a low-speed machine. In my opinion, this will in many cases constitute a serious objection to the use of a higher distribution voltage in the continuous-current system.

Thus assuming an extensive system with turbine-driven three-phase generators at the power house, the use of 1,300 volts or more, for the distributing system, while it will greatly increase the distance between sub-stations, will necessitate low speed, and hence expensive plant at the sub-station. On the other hand, a very favourable case would arise where it is preferable to have continuous-current high-voltage central stations with large slow-speed gas engines, at distances apart of from 30 miles upwards, dispensing with sub-stations.

It should thus be evident that in heavier traction work, a good many conditions affect the question in addition to the important one relating to the improvements which may naturally be expected in the single-phase commutator motor. As Mr. Lincoln points out, the development is proceeding as satisfactorily as could be expected, an alternating current equipment now costing but about 25 per cent. more than the equivalent continuous-current equipment.

Mr. Lincoln's justification for taking a lower percentage depreciation for the single-phase equipment for the reason that it results in a larger annual amount owing to the greater specific cost of the alternating current system, is a novel departure from accepted practice, and is the less permissible since it is generally conceded that the insulation of the field spools of the single-phase motor is much more difficult than for the continuous-current motor, and that the armature construction is less simple, particularly as regards the high resistance leads to the segments.

While it is the task of engineers to devote their energies to the development of the best system from the engineering standpoint, it is well to remember the small extent by which a relatively considerable engineering advance generally affects the success of an industrial enterprise. Thus, in fairly extensive traction systems the cost for power often amounts to well under a penny per car-mile, as against gross receipts of—say, 10d. per car mile, and it will take a far greater advance than the small percentage difference between the two systems discussed, no matter on which side the advantage lies, to materially affect the success of a traction enterprise. Intelligent management of the traffic far outweighs in importance the difference between any two thoroughly well developed systems. Both the systems under consideration are open to criticism on this score, and for a large amount of heavy traction work, continuous-current systems for less than 1,000 volts will probably still be installed.

H. M. Hobart.

London, *June 22nd*, 1904.

The Inquiry re the Board of Trade.

The committee appointed to consider what alterations, if any, should be made in the constitution and status of the Board of Trade and the Local Government Board have reported in a recent White Paper that the constitution of the Board of Trade is obsolete, as it never meets, and that its continuance is undesirable. They then recommend the appointment of a Minister of Commerce and Industry, with a salary of £5,000 per annum, and two assistants at £2,000 and £1,500.

Could not a Board of Engineering be formed, with authority to do all that the Board of Trade at present does in connection with shipping, harbours, docks, mines, railways, electric lighting and power stations, tramways, &c.?

Considering that engineering has been the chief factor in England's progress, it seems desirable that it should have a Government department to itself.

Could not the Institutes do something in the matter? Now that a committee has called attention to the subject, it seems a pity not to do something, if anything can be done.

Stator Rotor.

Electrical Continuity on Conduit Systems.

The recent correspondence with reference to improvements in metallic conduits brought the question of electrical continuity very much to the fore, and it seems to be generally agreed that all metallic conduits should be electrically continuous and earthed, whether "containing conductors conveying currents at pressures exceeding 250 volts" (see 1903 I.E.E. rules, No. 12), or at pressures below this. I

would like to point out, therefore, the following apparent anomaly :—Rule 65*b* says : "Lampholders must be insulated from any continuously-earthed conduit or sheath not forming part of the circuit." Now, as the lampholder is not only that part of the installation where leakage is most likely to occur, but also the part which is most likely to be touched, it certainly seems curious to suggest that it should be insulated. A lampholder-case with a charge of 200 volts above earth potential is an unpleasant thing to grasp in a damp situation. Perhaps someone will explain the reason of this rule ?

V. Zingler.

London, *June 17th*, 1904.

Radium: Can we Hear it ?

Perhaps one or some of your readers who are clever at constructing delicate microphones and telephones, would see if they cannot get some sort of a *sound* from these lively collections of matter like radium. [It would not be necessary to buy the stuff—one could get it on loan for a time.] It is a daring speculation to say that the sound or tune might be recorded.

J. C. R.

London, *June 18th*, 1904.

Homeward Bound!

We note your review of "Sewall's Wireless Telegraphy" in your issue of May 27th, in which you refer to the *poor* "stitching." We beg leave to inform you that the copies supplied to Messrs. Crosby Lockwood & Co. were in *sheets*, and were bound by them in England.

D. van Nostrand Co.,
W. H. Farrington, *Secretary*.

New York, *June 8th*, 1904.

[Poor old England !—Eds. E.R.]

Information Wanted. — A correspondent writes :—"Can you let me know the name of the manufacturer of a cardboard insulating material called 'Leatheroid'"?

BUSINESS NOTES.

Correction.—The address of Messrs. J. and T. Robinson, who have the installation contract for Purley Congregational Church (see our last issue) in hand, is not Brixton Hill, as stated. The firm is at Imperial Buildings, East Croydon, and at Sutton.

Book Notices. — The British Thomson-Houston Co., Ltd., of Rugby, has favoured us with a magnificent reprint of the description of the Central London Electric Railway which appeared in *Traction and Transmission* last year, from the pens of Messrs. H. F. Parshall, E. Parry, and W. Casson. It is a fine piece of work which will be a credit to our library shelves, and will always be useful for reference purposes.

"Elektrotechnisches Auskunftsbuch." By S. Herzog. Munchen and Berlin: R. Oldenbourg. M. 10.

A Technological and Scientific Dictionary. Part III. By G. F. Goodchild and C. F. Tweney. London: George Newnes, Ltd. 1s. net.

"Elementary Manual on Steam and the Steam Engine." By Andrew Jamieson. (Tenth Edition, revised.) London: Charles Griffin & Co., Ltd. 3s. 6d.

"Memoirs of the College of Science and Engineering, Kyoto Imperial University." Vol. I., No. 1.

"Die Prüfung von Gleichstrommaschinen in Laboratorien und Prüfräumen." Von Carl Kinsbrunner. Berlin: Verlag von Julius Springer.

Tramways and Light Railways Association Official Circular, June, 1904. Clun House, Surrey Street, W.C. Contains a full list of members and the articles of association.

"Fire Tests with Partitions." British Fire Prevention Committee, London; No. 83.

Exports of British Electrical Machinery. — The exports of British electrical machinery during May reached a total of £41,729, as against only £33,854 in the preceding month, and £38,799 in May, 1903. Notwithstanding this increase, this branch of our export trade has, so far this year, been rather quiet, the shipments during the first five months having attained a value of £170,886, as contrasted with £186,348 in the corresponding period of last year.

Russia.—La Compagnie d'Electricité du Midi de la Russie reports a profit of £4,366 for the last financial year.

Electrical Wares Exported.

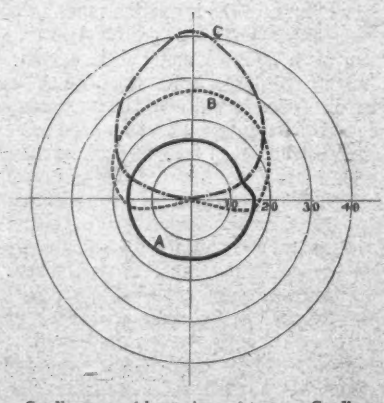
Week ending June 23rd, 1903.		Week ending June 21st, 1904.	
Adelaide	Value £112	Alexandria	Value £35
,, Teleg. mat.	52	Amsterdam	18
Alexandria	72	Auckland	262
,, Elec. launch	99	,, Teleg. mat	182
Amsterdam	21	,, Teleph. cable	1,867
Bombay	77	Bombay	109
Boston	15	Buenos Ayres	68
Brussels	90	Calcutta	673
Calcutta	1,604	,, Elec. machinery	1,091
Callao. Teleg. cable	7,500	Cape Town	362
Cape Town	107	,, Elec. machinery	7,756
Channel Islands	611	,, Teleg. mat.	382
Colombo	85	Christchurch	18
Constantinople	48	Colombo	132
Delagoa Bay	29	Cyprus	51
Durban	1,226	Durban	417
,, Teleg. mat.	557	,, Teleg. mat.	486
Flushing	20	Fiume	20
Hamburg. Teleg. mat.	130	Flushing	37
Hong Kong	64	Fremantle. Elec. machinery	124
Kobe	531	Hamburg	131
Lyttleton	260	Hong Kong	82
Madras	93	Kobe. Elec. lighting wire	288
Melbourne	14	Lisbon. Teleg. mat.	56
,, Teleg. mat.	45	Lyttelton	33
Montreal	130	Melbourne	28
Penang	45	,, Teleph. cable	79
Perth	30	Montreal. Teleg. mat	50
Port Elizabeth	96	North Atlantic. Teleg. cable.	6,200
,, Teleg. mat.	488	Ostend	90
Rio Janeiro. Teleg. mat.	200	Otago	99
St. Petersburg. Teleg. wire	34	Pernambuco	89
Shanghai	200	Perth	85
Singapore	220	Port Elizabeth	71
Sydney	821	,, Teleg. mat.	1,166
,, Teleg. mat.	96	Port Said	44
Tientsin	10	Saigon	13
Toronto	156	Shanghai	86
Valparaiso	35	Singapore	30
Wanganui	45	Sydney	1,129
Wellington	290	,, Teleg. mat.	150
Yokohama	577	Tokio. Elec. cable	1,884
		Valparaiso. Teleg. mat.	23
		Wellington	107
		,, Teleg. mat.	427
		Yokohama	2,304
Total	£16,435	Total	£28,957

Foreign Goods Transhipped.

Gothenburg. Elec. goods.	Value £129	Calcutta. Elec. mat.	Value 140
		Cape Town. Elec. mat.	55
		,, Elec. machinery	88
		Delagoa Bay. Telephones	252
		Melbourne. Elec. fittings	28
		Total	£513

Tests on "Linolite."—A pamphlet has been issued recently by the Linolite Co., of 47, Victoria Street, Westminster, embodying a report by Mr. J. S. Dow, on tests carried out by him at the Central Technical College. The experiments included tests of the distribution and intensity of light emitted by the lamp, with and without reflectors, in both horizontal and vertical planes. The results of some of the tests in a horizontal plane (at right angles to the axis of the lamp, which is of the tubular form, and at the level of its mid-point) are shown graphically in the accompanying figure.

It will be seen that the distribution without reflectors (A) is practically uniform round the lamp. The enamelled reflector concentrates the light on one "side" of the lamp, giving a fairly even distribution (B), and increasing the candle-power on that side by a large amount—80 per cent. in the direction of maximum intensity—and over a very wide angle. The polished enamel reflector still further concentrates the light (C)—160 per cent. in the direction of



——— Candle-power of lamp alone. ····· Candle-power of lamp with white enamelled zinc reflector. — · — · — Candle-power of lamp with polished aluminium reflector.

"Linolite" Candle-Power Curves.

maximum intensity—over a smaller, but still wide, angle. The increase amounts to more than 100 per cent. over an angle of 70°, and 50 per cent. over an angle of 100°. It will be seen, therefore, that for many purposes, in which light is required in certain directions only, the "Linolite" system is admirably suited.

Further experiments showed that the efficiency of both kinds of reflector was about 80 per cent. Curiously enough, the results obtained with a nickelled copper reflector were distinctly inferior,

in point of both distribution and efficiency, to those obtained with polished aluminium and enamelled zinc.

Auction Sales.—Messrs. Thomas Whitehead & Sons will next Monday, the 27th inst., offer for sale by auction certain electrical machinery, plant, tools, &c., by order of the trustee *re* De Lacey Bros. Messrs. Wheatley Kirk, Price & Co. will, on July 5th and 6th, offer for sale by public auction, certain engineering works and their contents, at Willesden Junction. Some particulars appear in our advertisement pages to-day.

Gloucester Tramways.—Messrs. S. Dixon & Son, Ltd., of Leeds, are to install four of their patent point shifters for Gloucester light railways within the next month.

Plant for Sale.—The Halifax Tramways and Electricity Committee is offering for sale one 50-KW. and two 100 KW. E.C.C. single-phase alternators, and two 120-KW. direct current generators, also 230 single-phase transformers, and an 8-H.P. Robey engine. See our advertisement pages for particulars.

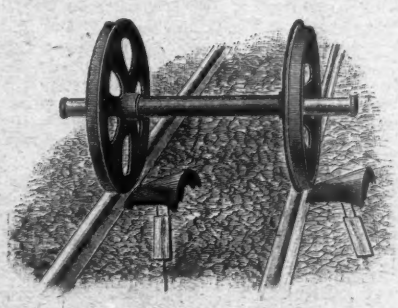
Brush Contracts.—The Brush Electrical Engineering Co. have secured the following contracts:—

Underground Railways Co., of London.—70 coach bodies, 170 trucks.
Birmingham and Midland Tramways Co.—160-KW. motor-generator and switchboard for Rowley Regis sub-station.

Creditors' Meeting.—A meeting of creditors of James Cairns & L. B. Draper (Cairns & Co., electrical engineers, 91, Queen Victoria Street, E.C., and at Luton) was held on Monday. Messrs. Poppleton and Appleby reported the results of their investigations, and stated that Mr. Cairns commenced business some 3½ years ago with a capital of £150 lent by his father. Draper joined him in March last, introducing £67 into the business, and promising to bring in further capital, but this had not been forthcoming. An offer to pay a composition of 13s. in the £ (payments to be spread over a period of nine months, at the expiration of which time debtors are to undertake to pay a further dividend equal to the value of the remaining assets), was considered by the meeting and was approved. The principal creditors were W. T. Henley's Telegraph Works Co., General Electric Co., Ltd., and Veritys, Ltd. The assets are estimated to produce £850, and there is a deficiency of £414.

Prosecution.—At Blackpool, on June 15th, Arthur Britch was committed for trial on a charge of obtaining electric cables and other electrical goods by false pretences from a number of electrical manufacturers. The value of the goods thus obtained is £54 9s. 6d.

Tramcar Replacing Frogs.—The accompanying illustration shows the replacing frogs which are being supplied by Mr. Fred J. Down, of 6, 7 and 8, Crutched Friars, E.C. In practical service it is necessary first to bend out the two copper wires connecting to the wrought-iron tail or anchor, so that it lies flat as shown; in this position the frogs are in electrical connection with the rails. It is claimed that the force of gravitation never admits of a derailed street car passing over these replacers, when placed as illustrated, on any pavement about level with top of track, without going laterally to the proper place on the track, as shown by the wheel marks. When it is desired to replace on a girder or T-rail, that stands above



REPLACING FROGS IN POSITION.

the surface, the replacer must be set on planks that come up about level with top of rails. In the position shown, the frog is in connection with the rail or return electric circuit, as is also the anchor through the connecting copper wires. If, therefore, all the car wheels are off the track and the circuit is dead, by pushing the flexibly connected anchor to the wheel, the circuit is again made, and the wheels can ride first over the anchors before mounting the frog and regaining the rail track, and this also tends to prevent the frog from slipping. If the car has gone a long way from the rails, a piece of wire put through the hole drilled in the frog and then connected to the wheel, also restores the circuit and enables the car to use its motors.

Curtis Turbines in St. Louis.—The Union Electric Light and Power Co. of St. Louis, which is a consolidation of the Missouri-Edison Electric Co., the Imperial Electric Light and the Citizens' Electric Light and Power Co. is building a large power station on the Mississippi river in North St. Louis. This power station, when completed, will supply all of the company's demands, shutting down three existing power houses with miscellaneous types of apparatus. This power station will have installed therein four 5,000-KW. and two 2,000-KW., 25-cycle, 6,600-volt alternators, direct-connected to Curtis turbines. In several sub-stations throughout the city motor-generators will be used for distributing direct current on 110 and 220-volt systems. The power station is being designed with a view of securing the highest possible economy of operation. Being located on the river front, and also having railway switching facilities, coal may be received by barges and by rail. The two 2,000-KW. turbines will be operated with Wheeler condensers; the four 5,000-KW. turbines with Worthington condensers. The Union Co. is to furnish the St. Louis Transit Co. with 9,000 KW. continuously, and the St. Louis Transit Co. is now installing two sub-stations. Sub-station No. 1 will have seven 1,000-KW. converters; sub-station No. 2 will have two 1,000-KW. converters. The distribution mains to the Transit Co.'s power stations will be underground.

Catalogues and Lists.—A copy of the abridged edition of "The Compleat Controller" catalogue, issued by the STURTEVANT ENGINEERING CO., LTD., of Queen Victoria Street, is to hand. It contains a number of leaflets illustrating and describing many types of apparatus suitable for motor control, including motor starters, slow-speed gear for ditto, "Igranic" field regulators, speed regulators, &c.; also main switches, change-over switches, and distribution accessories for traction and lighting. The leaflets are divided into two sections, white and yellow, the yellow leaflets referring to various specialities manufactured by the Electrical Transmission Co., of which company the Sturtevant Engineering Co., Ltd., are the proprietors. The entire range of motor-controlling apparatus is now manufactured in the company's works at 29, Bankside, and in the works acquired from the Electrical Transmission Co., at Hammersmith. Other leaflets dealing with various types of apparatus for special work, such as the control of motors driving machine tools, printing presses, lifts, cranes, fans, &c., can also be obtained on application.

A small pamphlet giving notes on various methods of power transmission in works and factories has been issued by the UNBREAKABLE PULLEY AND MILL GEARING CO., LTD., of West Gorton. The benefits of electric driving are emphasised.

A circular of direct and alternating current fans has been issued by MESSRS. JOHNSON & PHILLIPS. The firm's cable department has also sent us particulars of its "Malite" fire-resisting cable for electrical purposes.

A new catalogue of telescopic scaffold towers, extension ladders tower wagons, and other specialities of this class, has come to hand from MESSRS. HEATHMAN & CO., of Parson's Green, S.W.

Price list No. 200, issued by the BERGMANN ELECTRICAL WORKS, of 6, Victoria Avenue, E.C., gives particulars and illustrations of their patent arc lamp couplings.

MESSRS. FALK, STADELMANN & CO., LTD., are sending out a circular describing their Westenholz patent automatic gas lighter and extinguisher for street lamps.

MR. FREDERICK NELL, of 46, Queen Victoria Street, E.C., is circulating a new catalogue (June, 1904) of the "Victor" turbine, also pumping and condensing and air-compressing plant. The list (48 pp.) is illustrated with diagrams and half-tone blocks, and much of the data is arranged in tabulated form.

A list of electric accumulators for ignition purposes has come to hand from M. PAUL GADOT, of Levallois-Perret (Seine).

MESSRS. JAMES HOWDEN & CO., of Scotland Street, Glasgow, have just issued a preliminary catalogue of high speed engines for electric lighting and traction work, power transmission, mill driving, &c. Some photographs appear in the list of the firm's new shops which are equipped with modern tools and appliances for the exclusive manufacture of their double-acting type of engine. All parts are made to the closest limits of accuracy upon the interchangeable system. A list is printed of some of the more important installations in which the firm's engine has been adopted, and particulars appear of standard powers and speeds. Messrs. Howden are also licensees for the manufacture of the Parsons steam turbine for electrical purposes.

MESSRS. MARSH, SON & CO., LTD., of Gerrard Street, Soho, are issuing a circular showing one of their recent novelties in the shape of the "Cantie" switch. A quick make-and-break action is claimed, and it is stated that the blades are locked effectively in either the "on" or "off" position. A detailed description, with diagrams and prices, appear in the list.

A strongly-bound catalogue has come to hand from the ANDERSTON FOUNDRY CO., LTD., of Glasgow. It opens with a list of a few of the firms who are using the Anderston type of enclosed high-speed engines, and gives a list of various sizes of air compressors and engines which are held in stock. Some excellent illustrations show engines of different sizes coupled to electric generators. Electrically-driven, and other compressors, are neatly shown. Copies of the catalogue may be obtained upon application to the London address (Messrs. James Gordon & Co., 52, Lime Street, E.C.), or to the works at Glasgow.

Trade Announcements.—Messrs. Sturley Nunn Bros. and Co., electrical engineers, &c., are opening showrooms and offices at 39B, Culver Street, Colchester.

Messrs. Archibald Constable & Co., Ltd., have removed from 2, Whitehall Gardens to 16, James Street, Haymarket.

The works of the Morley Electrical Engineering Co., Ltd., have been removed to Troy Works, Stanningley, near Leeds, and all communications should be addressed there in future. The new works have been rendered necessary through increased business.

The Arc Works Annual Sports.—Last Saturday there was a large gathering of the friends and staff of Messrs. Crompton and Co., Ltd., at Chelmsford, on the occasion of the fifteenth annual bicycle and athletic race meeting. A number of the visitors first made a tour of inspection of the company's Arc Works, where luncheon was served. Colonel Crompton presided, and a toast

"Success to the Firm," was proposed by Sir Carne Rasch, M.P., and responded to by the chairman. Subsequently the party betook themselves to the ground of the Arc Works Club, in Wood Street. In all, the sports programme included some 30 items, including walking, running, cycling, tug-of-war, &c. The prizes were afterwards presented to the winners by Mrs. Crompton. It is stated that the meeting was the most enjoyable one that the club has ever held.

Liquidations.—By an order of the Court dated June 7th, 1904, Mr. E. J. Husey, of 58, Coleman Street, E.C., has been appointed receiver and manager on behalf of the debenture-holders of the Anti-Vibrator, Ltd. Until the claims of the debenture-holders have been satisfied, no payment can be made to the ordinary creditors.

Bankruptcy Proceedings.—The examination of John James De Lacy and Howard K. De Lacy, trading as De Lacy Bros., electrical engineers, of Liverpool, was, on June 16th, again adjourned, as, owing to the illness of one of the partners, no statement of affairs had been filed. The adjournment dates to July 14th.

New Zealand.—The New Zealand Customs authorities have given a decision to the effect that stranded copper wire is to be classified for purposes of import duty as "electrical appliances," the duty being 10 per cent. *ad valorem*.

LIGHTING AND POWER NOTES.

Acton.—On the 17th inst. a L.G.B. inquiry was held into the application of the U.D.C. to borrow £54,091 for E.L. purposes. The clerk explained that the money would be expended in constructing a distributing station and laying mains, &c. The Council had an agreement with the Metropolitan E.S. Co. for a bulk supply from its generating station at Willesden. The estimates are as follows:—Mains, £15,357; incandescent lighting, £1,745; feeders, £16,112; sub-station, including motors, generators, switchboard, accumulators, crane and buildings, £11,561. The consulting engineer to the scheme, Mr. W. H. Trentham, estimated that the demand for power would be at about the rate of 200,000 units for the first year, 450,000 for the second, and 500,000 at the end of the third. The Council had decided to charge consumers 5d. per unit for lighting, and 2d. for power. There was one opponent to the scheme who favoured a generating station combined with the dust destructor. It was also stated that the scheme was only passed by the casting vote of the chairman.

Bedford.—The accounts for the working of the E.L. undertaking for the year ending March 31st last show a profit of £745, which, together with the profit of £24 from the previous year, has been set aside to the district rate. The T.C. has decided to apply to the L.G.B. for sanction to a loan of £44,950 for additions, estimated by the electrical engineer as likely to be necessary during the next eight or ten years.

Church Stretton.—The U.D.C. has resolved to offer no objections to the proposed E.L. scheme.

H.M.S. "Clyde."—Electric light is to be installed on board H.M. training ship *Clyde* at Aberdeen, and a trench for the feeder is being dredged out up to the piers of the New Regent Bridge. The feeder is laid from the port hawser hole of the *Clyde*, and will be connected with a cable from Dee Village electric power station. The latter cable is already laid. The divers of the Aberdeen Harbour Board are being employed on the trench, under the supervision of Mr. W. Church, assisted by some of the electricians from Sheerness Dockyard.

Coventry.—The E.L. Committee, in its annual report, states that the capital expended during the year has been £16,758 11s. 2d., bringing the total expenditure to date up to £119,470 17s. 7d. During the year the number of consumers has increased from 449 to 536, and the equivalent of lamps connected from 39,605 (8 C.P.) to 73,746. Further connections are being made. The number of units sold has increased from 566,731 to 920,192, and the revenue from £8,076 7s. 9d. to £10,844 7s. 10d. The working expenses are £4,598 16s. 0¾d., as against £3,691 4s. 10½d. in the previous year. The profit on working is therefore £6,245 11s. 9¼d., as against £4,385 2s. 10½d. last year. The capital charges amount to £5,470 0s. 3d. The net profit, therefore, is £775 11s. 6¼d, as against a loss of £189 2s. 3½d. last year, and £1,807 19s. 7½d. the year before. The Committee recommends that the balance of profit, £775 11s. 6¼d., be carried forward to next year's account. This is the first year the undertaking has shown a net profit, and Mr. Jeckell, the borough electrical engineer, is to be congratulated on the success which has attended his bold scheme of reorganisation and extension.

Dalkeith.—A dispute has arisen in connection with the electric lighting of the town, for which Messrs. Crompton & Co. have an arrangement with the T.C. The T.C. has written to the B. of T., intimating that the company require the Council to guarantee 3,000 hours per annum, and that this is no part of the original contract. The Council contends that, until the light is switched on, Messrs. Crompton & Co. are in default with regard to the contract.

Croydon.—Mr. A. C. Cramb, borough electrical engineer, has notified the Croydon R.D.C. that the Croydon Corporation is about to apply for a prov. order to supply electric light to the outlying districts of Purley and Sanderstead. Both districts are increasing rapidly, and many applications for electric light have been received.

An order is to be placed with Messrs. Ferranti, Ltd., for extensions to the main switchboard rendered necessary by the installation of the new 750-KW. alternator, which will be erected this summer.

The Corporation recently considered the question of mains extensions, and decided to expend the following amounts:—Switchboard extensions, £197; mains to Purley, £1,300; Portland Road, £800; alterations and extensions to the D.C. main in the centre of the town, £513. A recommendation to borrow £20,000 for mains extensions was referred back for full details.

Falkirk.—The result of the past year's working, ended May 15th last, is as follows:—Capital expenditure £25,370, as against £21,030 last year; generating costs, management, &c., £1,095; revenue, £2,146, leaving a balance of £1,051. The debt balance at the beginning of the year was £202, and after paying interest, sinking fund, &c., the debt balance is now £164. The units sold amounted to 128,855, and the average price obtained was 3·285d., the total cost per unit being 2·04d. The equivalent number of 8-C.P. lamps connected amounted to 7,931.

Fleetwood.—The electric lighting syndicate has reduced the price of energy for public lighting from 4d. to 3d. per unit.

Germany.—The municipal authorities of Lübz have decided to establish a central electric lighting station in the town.

Gorton.—The urban district of Gorton some years ago obtained an electricity order, with the view of setting up generating plant and supplying electricity on its own account. Before beginning operations, however, the Council counted the cost, and came to the conclusion that for a purely industrial district a local lighting scheme would be too expensive. Terms have now been practically arranged with Manchester, and the order will, in the near future, be handed over to the city, which can supply electricity more economically.

Huddersfield.—The T.C. has appointed a committee to consider the question of the development of motive power supply in the town.

Hove.—Messrs. Handcock & Dykes have been retained by the Corporation of Hove to prepare a specification for a system of underground mains for the electric lighting of Aldrington, the Brighton Corporation giving a supply of energy in bulk, as mentioned last week.

Italy.—Application has been made for a concession to put down a plant, to utilise the water power of the River Torre in the generation of electrical energy for lighting and power purposes at Udine.

Kirkintilloch.—The T.C. has resolved to make inquiries as to the terms on which certain authorities would be willing to take up its E.L. order.

Leigh.—Mr. G. F. Metzger, consulting electrical engineer, was last week authorised to advertise for tenders for the supply and fixing of a 350-KW. steam-driven generating set, and also for the erection of a new switchboard. The borough surveyor was instructed to prepare plans and specifications, and to obtain tenders for the buildings required in connection with the works extensions. The electrical engineer, Mr. D. M. Kinghorn, is to obtain tenders for the supply and fixing of a mechanical stoking apparatus for use in connection with the new boiler. It was resolved that Mr. Metzger be paid 50 guineas on account of services rendered with respect to the extensions. The town clerk was instructed to inform Messrs. W. R. Renshaw & Co., Ltd., that the accessible boiler erected by them was unsatisfactory, and to require them forthwith to remove the same.

In moving the adoption of the Electricity Committee's proceedings, Alderman W. Smith remarked that there was an increase of 116,000 units in the amount sold, and the great bulk of this was for power purposes, which was sold at a low rate, and which covered the costs of generation and distribution, but provided very little towards the capital charges. It followed, of course, that any profit which was made came from the consumers for lighting purposes. If they took care that the sale for power was made and kept subservient to its proper function as an electric lighting station, he had every confidence in the future of the department.

It is by such a policy that the doom of the small municipal electricity works will be sealed. Unless they recognise that power units pay their fair share, and are really far more profitable than lighting, they will necessarily be ousted by the power companies, who know what is wanted and supply it.

Leyland.—The U.D.C. has applied for a three years' extension of the E.L. order.

Lowestoft.—From July 1st electrical energy will be supplied at 5½d. per unit.

London.—WESTMINSTER.—The Works Committee of the City Council reported on Wednesday last week having considered a letter from the Westminster Electric Supply Corporation, Ltd., stating that since clearing up the accounts for re-instatement charges for 1903 they have been looking into the accounts for 1901 and 1902; that, in view of the recent decision in this matter, they have been considerably overcharged on each of those years; setting out certain figures, and referring to the charges for relaying York stone paving; stating that their vouchers and figures are open to inspection at any time, and asking that the accounts be fairly adjusted. The Committee decided to reply that it could not see its

way to adopt the suggestion that the accounts for 1901 and 1902 be adjusted. The same committee further reported that it had informed the Charing Cross and Strand Electricity Supply Corporation that counsel's opinion was, that in the event of the Corporation not being content to leave their main where it is when the work of straightening Crown Court is completed, the City Council will not be liable for the expense of removing the same.

MARYLEBONE.—In a report issued on Tuesday last week, the Electric Supply Committee of the B.C. stated that it had (subject to the necessary confirmation) entered into an agreement with the Metropolitan Electric Supply Co. embodying the following terms:—

(1) The supply by the company of electricity within the Marylebone area to continue until March 31st, 1905, up to which date the company will give the entire supply, and thereafter the consumers to be taken over by the Council gradually as they are in a position to supply them from their own generating station, the supply by the company to entirely cease not later than March 31st, 1906. (2) The company to take all revenue from the consumers supplied by them, and in consideration thereof to pay to the Council in each quarter ending March 31st, June 30th, September 30th, and December 31st respectively, a sum in respect of interest on the amount of the capital sums payable by the Council to the company under the award or in the action, such interest to be at the rate of 4 per cent. per annum from July 1st to December 31st, 1904, 3½ per cent. from January 1st to June 30th, 1905, and 3 per cent. per annum from July 1st, 1905, to March 31st, 1906, provided that when the transfer of consumers from the company's to the Council's supply shall have commenced, the payments to be made to the company shall be the proportion of the interest for the respective quarters which the sums receivable by the company bear to the aggregate sums receivable by both the Council and the company. (3) The Council to have complete control over capital expenditure. (4) The charges for the supply of energy by the company to remain as at present.

The same Committee further reported having resolved to invite tenders, to be delivered on the 6th prox., for the building contract of the generating station, for the steel work, and for the electrical plant. The Finance Committee reported having been in communication with various lenders with a view to obtaining a temporary loan of £1,300,000, in order to pay the Metropolitan Electric Supply Co. on the 30th inst., the sum necessary to obtain the transfer of the business under the award and the various judgements of the Courts. The Finance Committee of the L.C.C. had previously recommended the L.C.C. to advance the B.C. the total amount of the loan (£1,415,000), for which it had statutory authority, on or before October 31st; that Committee had since given the B.C. a satisfactory assurance that it might rely upon receiving the money not later than October 20th. The B.C. had arranged with the London and Westminster Bank to advance the sum of £500,000. With regard to the remaining £800,000, Messrs. Pember and Boyle had arranged with certain clients for a loan of this amount, less interest at the rate of 3½ per cent. per annum against orders on the Council's treasurer to pay the amount on "October 20th fixed." The Parliamentary agents and Mr. Macmerran, K.C., had been consulted upon the matter, and had advised that the Council would run no risk in authorising the signature of these orders in the usual way. The Works Committee reported having considered what should be done in view of a portion of the depôt premises in Richmond Street having been taken over for a site for a generating station; it had decided in favour of accepting as a temporary expedient, an offer from the Central Electric Supply Co., Ltd., of an acre of land abutting on Lodge Place, at a rent of £850 a year. The General Purposes Committee reported having asked the Edison & Swan United Electric Light Co., Ltd., to quote prices for one year for the lamps required, about 1,686, in the various departments of the Town Hall.

BERMONDSEY.—A L.C.C. loan of £28,589 for the electric lighting undertaking was taken up by the B.C. on Tuesday. A letter was received from the Provident Clerks and General Accident Insurance Co., stating that in view of the heavy loss during the past two years on insurances under the Workmen's Compensation Act on workmen in electricity and dust destructor works, they were compelled to raise the premium to 14s. 6d. per cent. Even this rate was insufficient, and was only fixed in the hope that the risk would improve.

HACKNEY.—An expenditure of £440 for mains extensions has been sanctioned by the B.C. Representation is to be made to the B. of T. with a view to the deletion of clause 6 from the Supply of Electricity Bill.

HAMMERSMITH.—The B.C. has received from the L.C.C. consent to borrow £10,634 for E.L. purposes.

The B.C. has decided to oppose the Supply of Electricity Bill now before Parliament.

On Wednesday last week, the B.C. resolved to invite tenders for excavating for the extension of the boiler house for the electricity undertaking.

POPLAR.—The Electricity Committee of the B.C. has decided in favour of lighting Cotton Street with arc lamps at an estimated cost, including the necessary mains and distributors, of £388.

Representations are to be made by the B.C. to the B. of T. against Clause 6 of the Supply of Electricity Bill. Mains extensions, estimated to cost £100, are to be carried out.

STOKE NEWINGTON.—The E.L. Committee of the B.C. on the 21st inst., presented a report recommending that an agreement for taking a supply of energy in bulk from the North Metropolitan Electric Power Supply Co. be entered into. The price agreed upon is at the rate of 3½d. and 1d. on a maximum demand for 100 hours per quarter. Provisions for terminating the agreement, revision of prices, damages in default of supply, &c., are made. The existing agreement with the Hackney B.C. is to be determined after commencement of supply. The cost of laying the necessary mains, &c., including land for transformer station, storage batteries, meters, &c., would be about £33,300. It is estimated that about three-fourths of the supply would be charged at the minimum, and after allowing for a 25 per cent. loss in transmission, the total cost to the Council would be 2·16d. in addition to transforming and distributing costs. The price to be charged to consumers is 5d. per unit. The Committee recommends, in the first place, that mains be laid in six thoroughfares, at a cost of £22,560. The annual outlay, apart from the payment for the energy supplied, is estimated to be:—Interest and sinking fund, £2,330; salaries and wages, £360; maintenance and depreciation, £770; total, £3,460. The consideration of the report was adjourned.

Louth.—The Corporation has applied to the L.G.B. for sanction to spend £17,000 on the electric lighting of the town, the Corporation having decided to keep the order in its own hands, and not to enter into the proposed agreement with the National Electric Construction Co. At the last meeting, Messrs. Handcock and Dykes, of Westminster, were instructed to prepare the necessary plans forthwith.

Mexborough.—The U.D.C. has resolved to apply for sanction to borrow a loan of about £5,500 for extensions at the electricity works, &c. The chief items are:—Two new generating sets, £1,316; boiler and foundations, &c., £800; distributors, £420; street lighting, £150; switchboard, £75: pipework, £75.

Partick.—The T.C. has obtained the approval of the Secretary for Scotland for the borrowing of £18,000 for the execution of works under its E.L. order.

Radcliffe.—The generating station at Radcliffe is now completed, and the supply of electricity to the district will begin immediately. The maximum price to small consumers will be 5d. per unit, large consumers being allowed a reduction. The tramways in Radcliffe, which are to be worked by the Bury Corporation, will be supplied with power from the new works. The laying of the lines from Radcliffe Bridge to the Whitefield boundary is about to be commenced. At this boundary there is a connection with the Salford system, and a through service between Radcliffe and Manchester is contemplated.

Ravensthorpe.—The U.D.C. proposes to apply to the L.G.B. for a prov. order for electric lighting.

Rhyndwyclydach.—The P.C. has resolved to apply to the L.G.B. for permission to adopt the Lighting Act, for the purpose of erecting an E.L. plant to serve the streets of Clydach and Trebanos.

Spain.—La Sociedad Nueva Central Electrica Valenciana de Electricidad is putting down a plant to utilise the water power of the river Villamarchante. It is stated that about 1,500 H.P. will be available. Four sets of 500-H.P. turbines and dynamos are being put down.

Stockton Heath.—Warrington T.C. has offered to supply electricity to Stockton Heath at the same price as charged within the borough.

Surbiton.—The U.D.C. has resolved, on the recommendation of its Highways Committee, to apply to the B. of T. for an extension of its E.L. order, so as to include the whole of the urban district.

Swinton and Pendlebury.—At the last meeting of the U.D.C., a report was presented by the Tramways and Electricity Committee, recommending that negotiations should be opened with the Edmundson's Electricity Corporation for taking over the Council's electric lighting order on the terms of a draft agreement submitted to the Committee. The recommendation was agreed to.

Twickenham.—The B. of T. has been applied to by the U.D.C. for the extension of the E.L. order, so as to include in the lighting area the parishes of Tolworth and Hook.

Walsall.—The T.C. has sanctioned extensions of the E.L. mains at a cost of £447.

Walthamstow.—Application is to be made to the L.G.B. by the U.D.C. for leave to borrow £394 for mains extensions, and £606 for installing the electric light in Higham Hill and Queen's Road schools.

Watford.—The Watford U.D.C. considered at its last meeting the question of pumping water by electricity. Mr. W. F. Colebrook, the electrical engineer, was writing to towns in Germany, where it was stated electricity was used in connection with water-works. The installations on the Continent ranged from 300 H.P. to 3,000 H.P. The Council decided to consult Mr. C. Hawksley, who is connected with the water-works scheme, on the matter.

Widnes.—The T.C. has sealed an agreement with the Mersey Electrical Supply Co., Ltd., for the transfer of the Corporation's E.L. orders, 1901 and 1904.

Willesden.—Mains extensions, estimated to cost £2,369, were sanctioned by the U.D.C. on Tuesday.

Wisbech.—The National Electric Construction Co. has informed the T.C. that, in connection with the E.L. scheme, it is prepared to deposit for seven years in the joint names of the

Council and the company an amount equal to the annual sinking fund and interest payable to the Council, as a security other than the personal guarantee which the directors proposed to give.

TRAMWAY AND RAILWAY NOTES.

Belfast.—The Belfast and Co. Down Railway is about to introduce two electric cars on the Bunfor branch for experimental purposes.

Birkenhead.—For the year ending March 31st, the tramways carried 11,327,932 passengers, an increase of 936,947, or 9 per cent. The total income amounted to £56,073 against £52,876, an increase of £3,197, equal to 6 per cent. The working expenses were £34,747, against £30,367 in 1903. The net profit was £1,883, against £3,598 in 1903. Energy consumed: 2,128,607 units, against 1,953,095 units. The working expenses showed an increase of ·48d. per car-mile on last year. After experimenting with steel-tired wheels, it had been decided to gradually equip the whole of the rolling stock with steel-tired wheels, owing, it is said, to the liability of the chilled cast-iron wheels now in use to develop flats. The total route length is now 13·52 miles; single track, 23·53 miles.

Clydebank.—At a meeting of the T.C. a letter was read from the manager of the Glasgow Corporation Tramways stating that they had arranged to lay the track for the extension of the car system as far as the canal bridge at Dalmuir this season. When all the arrangements for the construction of the canal bridges had been made—which was a rather difficult matter—they would proceed with the extension to the boundary of the burgh at Dalmuir, and also the line along Kilbowie Road. It was not their intention to lay the work for the Kilbowie Road bridge until they were laying the branch line there, as such work rapidly deteriorated when unused. It was agreed by the T.C. to intimate to the Lanarkshire and Dumbartonshire railway that it would be necessary to lower the road 18 in. under their bridge to admit of the tramways being constructed to Dalmuir, and proposing that the work be carried out and that the cost be apportioned between the railway and the Glasgow Tramways Department.

Falkirk.—The T.C. on Monday evening heard the minute of the Tramway Committee which contained the result of the plebiscite of the ratepayers on the question of the running on Sundays of the electric tramways which the Falkirk and District Tramway Co. propose to construct. The vote was:—In favour, 2,097; against, 1,108; majority in favour, 989. The number of plebiscite cards issued was 4,600, and 3,205 persons voted.

Great Northern and Brompton Railway.—A claim against the Great Northern, Piccadilly and Brompton Railway Co. for injury to certain premises in Tonbridge Street, King's Cross, was considered at the Under-Sheriff's Court last week. It was said that the subsidence of the said premises was due to the tunnelling operations of the company, but the Court gave judgement for the railway company.

Heywood.—The T.C. is applying for an extension of time in which to reconstruct and electrify the tramways.

Leamington.—An extension of time for the completion of the electric tramways has been applied for by the Leamington and Warwick Electric Co.

Liverpool.—On Tuesday last week a car when descending the gradient of Kirkdale Vale, jumped the rails, and continuing on its way, mounted the sidewalk, and damaged two houses.

London.—The electrification of portion of the lines of the Metropolitan Electric Tramways, Ltd., is now approaching completion, and the first electric car was in the neighbourhood of Wood Green last week. It is expected that the Board of Trade inspection will take place by the end of the month, and that a service of electric cars will be operated immediately thereafter.

Manchester, Gorton, and Reddish.—A new tramway route to connect these places is shortly to be provided by way of Ashton old road. The Manchester Tramways Committee recently agreed with the Gorton District Council to lay a length of line in Gorton Lane, Wellington Street, and Reddish Lane, and to work them on a lease on the same terms as the tramways in Hyde Road, which also run through the Gorton urban district. By the new route all the great industrial establishments on the Gorton side of Manchester will have convenient facilities for travelling, as they have already on the Openshaw side.

Rochester.—The Tramways Committee recommends the Council to accept the tender of Messrs. Dick, Kerr & Co. for permanent way and overhead equipment work for the Star Hill and New Road section of the tramway system. The Rochester Tramways Act, which was passed in August last, authorises Rochester City Council, amongst other things, to construct a tramway from High Street, up Star Hill, and along New Road, Rochester, to the Chatham borough boundary. From this point the work devolves upon the Chatham and District Light Railways Co., whom Act authorises them to continue the tramway along New Road, Chatham, to Luton Arches, where junctions with the High Street, Luton, and Chatham Hill lines will be effected. The construction of the main tramway will, it is stated, be deferred for two or three years. A system of main drainage and some very important street widenings, involving the purchase of considerable property, have to be carried out before the tramway scheme in its entirety can become an accomplished fact.

South Staffordshire.—On Wednesday in last week the steam tramcars running between Wednesbury, Darlaston, Dudley, and Tipton were bodily withdrawn, and now there are loud complaints on the part of the travelling public. It is understood that there will soon be a conference between representatives of the governing bodies and of the tramway company, and it is hoped that one result will be a speedy electrification of the lines and a resumption of traffic.

Stalybridge and Ashton.—The dispute over the tramway arrangements between Ashton-under-Lyne and Stalybridge is causing much public inconvenience. The Ashton cars now run only to the boundary of the borough at Stamford Park. The joint board is endeavouring to mitigate the inconvenience by running cars by way of Dukinfield at intervals of 20 minutes. But the journey occupies a much longer time than by the old route, and many, who would gladly use the trams, now travel by rail. A settlement of the difficulty by arbitration is recommended.

Stockport.—The T.C. is negotiating for the purchase of the Hazel Grove tramways. They are laid in the principal thoroughfare in the town, and there is a branch line to Edgeley. The tramways are the property of a company which has regularly paid 10 per cent. interest to its shareholders. It was stated at a meeting of the company's shareholders last week that the Corporation was prepared to give £23,000, but the company is holding out for £25,000 on £1 9s. per share. The cost of electrification is estimated at £80,000.

Tyneside.—Mr. W. R. Plummer, M.P., for Newcastle-on-Tyne, has given notice that when the Tyneside Tramways Co.'s Bill comes before the House of Commons, he will move to delete the clauses which propose to give that company running powers over the Newcastle-on-Tyne Corporation tramways.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones.—It is stated that the Corporation telephone accounts and balance-sheet to March 31st last, just published, "show a loss of £1,875, after charging £1,430 of general expenses to capital, and without setting aside anything for depreciation, as provided in the estimate."

Continental.—A correspondent writes:—"There are some interesting things to be seen just now at the Paris Central Telegraph Office. The most important, from a practical point of view, is an improvement in the Baudot telegraph. The apparatus now generally in use has five keys, and it is possible to send one combination at each revolution. With the improved apparatus there are eight keys, the extra three being devoted to the vowels and the blank. This increases the output very considerably, the comparison being as 5 : 3. For example, by the old method, in sending such a word as 'Paris,' it required five revolutions for the word, and one for the blank which followed, or six in all. By the new method, this word is sent thus:—PA : RI : S. blank, and requires only three revolutions to complete it. The system is working to Marseilles, and giving splendid results.

Herr Pollak is engaged in a series of experiments at the same office with his fast-writing telegraph, which are proving very successful, and are impressing the Press-men of France. The wires are hired by the hour for Press purposes in France, and the possibility of squeezing such an enormous quantity of matter into an hour's working as is promised by Herr Pollak is very attractive to newspaper proprietors. The apparatus used is the same as that described in these columns as the Pollak-Virag telegraph, with some few mechanical improvements introduced since the death of Herr Virag, chief among which are the preparation of the perforated ribbon by means of a typewriter keyboard."

Imports of Foreign Telegraph Cables.—There was rather a large importation of foreign telegraph cables and apparatus into this country during May, the returns showing a total of £4,286 as against only £979 in the corresponding month of last year. Notwithstanding this, however, the imports during the first five months of the year shows a substantial decline, they having amounted to only £14,813 as contrasted with £26,618 in the five months ending with May, 1903.

The Nicolson Cable Code System.—The delegate of the Argentine Republic appointed to represent that country at the last International Telegraph Conference, held in London last year, brought officially to the notice of the other delegates a system of code words as arranged by Mr. Alex. McL. Nicolson, which was reviewed in our issue of June 12th, 1903. It was the object of Mr. Nicolson, we believe, to have his system adopted by the conference as the universal one to replace the official vocabulary compiled by the Bureau International des Administrations Télégraphiques at the request of a previous conference. The adoption by the last conference of a 10-letter pronounceable code or cipher word was rather

a more liberal concession than was generally expected, and, as far as economy is concerned, robbed many a system invented of its merits and claims in this direction.

Mr. Nicolson has now followed up his efforts by publishing vocabularies of code words built upon the lines of his system, a detailed description of it being given in a circular just to hand. The vocabularies apparently are arranged in a manner so that they may be easily converted into code books, and this we think a step in the right direction. The circular states that 10,000,000 words on the Nicolson system are now available, and each differs from the other by at least two letters. We consider that sound principles have been adopted in the working up of the system, and discarding letters which in signals closely represent other letters, should be a step towards eliminating the frequent errors arising from this cause. Mr. Nicolson, by the nature of his occupation, is specially fitted to draw up a system and appreciate the lines upon which he should proceed, and the cost of the vocabularies should be no bar to its adoption by the general public. Vocabulary I., Part I., contains 125,000 numbered words, and nearly 15,000 spare ones, and costs £3 10s. Part II., also containing 125,000 words, may be purchased at the same price, and the above two parts, bound as one volume, can be obtained for £6. We have a leaning rather towards a vocabulary such as published by Beme, providing it can be made perfect; but, in its absence, a recognised source from whence letter combinations could be derived, such as the vocabularies under review, would be an inestimable boon. The publishers are the Botolph Printing Works, 8, Gate Street, Lincoln's Inn Fields, W.C., and Messrs. Whittaker & Co., 2, White Hart Street, Paternoster Square, E.C.

Persian Telegraphs.—It is stated by an Indian exchange that the new land telegraph line through Persia, will be opened for public use shortly.

Portsmouth Telephones.—Mr. W. T. Dittman, at the last week's Council meeting, submitted the balance-sheet for the year ending March 31st last, in connection with the Municipal telephone undertaking. This, he mentioned, was the first report, and the undertaking had come successfully through a time of stress. The surplus on the 13 months' working was £1,260, and that was after paying principal and interest. The actual profit was £2,370, and this out of a revenue of £6,000, was considered very satisfactory.

Retrenchment.—We make the following extract from the *New Zealand Press* of April 15th:—"The Eastern Extension Cable Co. have intimated to the postal administration that the conveyance, free of charge, of meteorological observations between New Zealand and the States of the Commonwealth will cease after May 1st. The company point out that, in view of the Pacific Cable Co. being available for the purpose, they can no longer continue the service."

Telegraphic Interruptions and Repairs:—

Cables.		Interrupted.	Repaired
Dominica-Martinique		May 5, 1904	
St. Lucia-Martinique		May 7, 1904	
Trinidad-Demerara No. 1		Aug. 27, 1901	
Cayenne-Pinheiro		Aug. 18, 1902	
Anjer-Kalianda		Aug. 2, 1902	
Reissa-Issa (Yemen)-Camaran		Oct. 22, 1902	
Tarifa-Tangier		Jan. 18, 1904	
Closed { Nagasaki-Vladivostock		Feb. 15, 1904	
Closed { Port Arthur-Chefu		Feb. 18, 1904	
Foochow-Formosa		Feb. 11, 1904	
Acora-Lagos		June 1, 1904	
Nagasaki-Fusan		June 7, 1904	June 20
Chio-Ténédos		June 21, 1904	
Landlines.			
Seoul-Masampo		Feb. 13, 1904	
Seoul-Gensan		Feb. 13, 1904	
Anju-Ping-Yang		Feb. 25, 1904	
Ninguta-Vladivostock		March 2, 1904	
Dominican lines		May 26, 1904	
Kertsch-Odessa		June 16, 1904	June 16

Communication between Caimanera and Santiago-de-Cuba interrupted 6th inst.

Communication between Cienfuegos and Santiago-de-Cuba interrupted 17th to 21st inst., cutting off West Indies *via* Key West.

Wireless Telegraphy.—Under the auspices of the French Post and Telegraph Department, M. Rochefort is now carrying out a series of experiments with his system of wireless telegraphy. This is the system at present working for railway purposes between Newhaven and Dieppe. The present experiments, which are overland, and at a distance of from 20 to 30 miles, are taking place at Melun and Villejuit. Up to the present, very satisfactory results have been obtained, excellent signals and perfect isolation having been the main features. The speed has varied from 150 to 200 words per hour. M. Rochefort will, at the conclusion of the experiments, start for America with his apparatus for the purpose of taking part in the forthcoming St. Louis Exhibition competition.

Mr. Jos. Newey, Chief Inspector of Public Works in Cape Colony, in the course of his recently presented annual report, observes that the installation of wireless telegraphic apparatus upon Bird Island and Dassen Island appears to be within measurable distance of accomplishment. The proposals contemplate the actual work of erection and maintenance of the plant, &c., being undertaken by Lloyd's Committee upon sites to be approved by a board composed of representatives of the departments concerned. So far as this department is concerned, the means of communication which will then be established will, it is anticipated, prove of the greatest utility.

CONTRACTS OPEN AND CLOSED.

OPEN.

Argentine Republic.—The municipal authorities of Rosario (Santa Fé) are at present inviting tenders for the construction of an electric tramway in the town.

Ashford.—June 24th. Tenders have to be lodged with the West London District School by 11 a.m. to-day for the electric light wiring of new class rooms and the porter's lodge at their Ashford School.

Aston Manor.—July 18th. Pipe-work for the electricity works. See "Official Notices" to-day.

Bridgend.—July 6th. Telephone and fire alarm installation for asylums. See "Official Notices" to-day.

Bulgaria.—July 4th. The District Finance Commission at Sophia is inviting tenders until July 4th for an installation of electric lighting in the Government printing works in that city.

Bulgaria.—August 13th. The Municipal Authorities of Phillippopolis are inviting tenders until August 13th for the concession for the electric lighting of the town and for the construction and working of an electric tramway.

Clyde.—July 25th. Two 32-ton electric coaling hoists for Clydebank Dock. See "Official Notices" June 17th.

Edinburgh.—June 27th. Electric supply cables for one year. See "Official Notices" June 17th.

Erith.—July 11th. Rails, fishplates and bolts; permanent way construction for the U.D.C. tramways. See "Official Notices" June 10th.

Exeter.—July 1st. One 200-KW. engine and generator, condenser, &c. See "Official Notices" June 17th.

Felixstowe.—July 9th. Extensions to feeders. See "Official Notices" to-day.

Handsworth.—July 11th. Water-tube boilers, engines and dynamos, crane, battery, arc lamps, and posts, switchboard and boosters for electricity works. See "Official Notices" to-day.

Heston and Isleworth.—July 4th. Electricity meters for the U.D.C. See "Official Notices" June 17th.

Holland.—July 2nd. Tenders are being invited until July 2nd by the municipal authorities of Utrecht for the establishment of a central electric lighting station in the town.

Johannesburg.—July 4th. Cables, conductors, and accessories. See "Official Notices" May 13th.

Johannesburg.—July 29th. Steel work for car-shed buildings, and bridge over railway. See "Official Notices" June 17th.

Leicester.—July 5th. Machine tools for the tramway department. See "Official Notices" to-day.

London.—July 12th. Three 3-ton electric travelling cranes and two electric locomotives for the wharf of the Greenwich power station of the L.C.C. See "Official Notices" June 17th.

London.—July 12th. The L.C.C. wants tenders for various overhead travelling cranes, and lifting tackle for Greenwich station. See "Official Notices" June 17th.

Loughborough.—June 25th. Cable, switchboard and piping. See "Official Notices" June 10th.

Manchester.—June 30th. Motors, motor starters, cables, troughing, fuse boxes, &c. See "Official Notices" June 17th.

Manchester.—July 11th. The Paving, Sewering and Highways Committee invite tenders for laying underground telephone pipes (Contract No. 10), with other appurtenant works. Specification, &c., at the City Surveyor's office, Town Hall, Manchester (£2 2s.).

Penrith.—July 5th. Two oil or gas engines and dynamos; switchboard and boosters; battery and mains for electricity supply. See "Official Notices" June 17th.

Radcliffe.—June 27th. Electricity meters for the U.D.C.

Richmond (Dublin).—July 5th. The Joint Committee of the Richmond District Asylum invite tenders for a high-speed engine and dynamo, direct-coupled, for their Portrane Auxiliary Asylum, near Donabate, County Dublin. Specification at the Asylum Offices, Grangegorman, Dublin.

Rochdale.—June 27th. Removal of lighting and traction switchboards to new switchroom; reconstruction of lighting switchboard, &c., at the electricity works. See "Official Notices" to-day.

Rochdale.—July 1st. One 412-KW. steam dynamo. See "Official Notices" June 17th.

St. Pancras.—June 28th. Cables and carbons. See "Official Notices" June 17th.

Shanghai.—July 30th. The Municipal Council invites tenders for a 24-mile electric trolley line concession. Particulars from J. Pook & Co., 63, Leadenhall Street, E.C., the London agents of the Council. See "Official Notices" May 13th.

Spain.—July 6th. The Spanish Ministry of Public Works is inviting tenders until July 6th, for the concession for the establishment and working of an electric tramway between the Calle de Hurtado de Amezaga, and the Plaza Circular in Bilbao. Tenders are to be sent to La Direccion General de Obras Publicas, Madrid, whence particulars may be obtained.

Spain.—July 15th. The Spanish Ministry of Public Works in Madrid is inviting tenders until July 15th for the concession for the construction and working of an electric tramway between Sarria and the foot of Vallvidrera mountain (province of Barcelona). Tenders are to be sent to El Ministerio de Obras Publicas, Madrid, whence particulars may be obtained.

Stepney.—June 28th. Electric wiring for the public baths. See "Official Notices" June 10th.

Stepney.—July 4th. Meters, demand indicators, and arc lamp carbons for the electricity department. See "Official Notices" to-day.

Stourbridge.—July 8th. Mains (paper), solid system for the U.D.C. See "Official Notices" to-day.

St. Pancras.—July 19th. Main switchboard at King's Road station. See "Official Notices" to-day.

Swansea.—July 1st. Two tramway switchboards. See "Official Notices" to-day.

Warrington.—July 12th. Steel poles and overhead equipment for light railways, including special swing bridge work over the Ship Canal. See "Official Notices" to-day.

Zanzibar.—Electric lighting and traction are to be introduced throughout the town and port of Zanzibar. Particulars from A. S. Rogers, Regent and Prime Minister to the Sultan of Zanzibar.

CLOSED.

Clydebank.—Messrs. Cowans, Sheldon & Co., Ltd., of Carlisle, have secured the contract for the supply of a 150-ton electric derrick crane to Messrs. John Brown & Co., Ltd., of Clydebank.

Coventry.—The E.L. Committee has accepted the tender of Messrs. Aiton & Co., of London, for pipe work, at £672, and that of Messrs. Kelley & Son for the extension of the engine house, at £945 19s.

Exeter.—The City Council has accepted the tenders of Messrs. Dick, Kerr & Co., Ltd., for the construction and equipment of 5¼ miles of electric tramways on the overhead trolley system through the main streets of the city:—

Construction of track, £29,227.
Equipment, £3,641.
Cars and equipment, £2,898.

Glasgow.—In connection with the Western District Sewage Works of the Corporation, Messrs. D. Stewart & Co., Ltd., have secured the contract to supply electric motor, shafting, &c., for driving the oxidisers in the chemical house, at £352.

Leeds.—The Tramways Department has accepted the tender of the Sunbeam Lamp Co. for the supply of 11,000 of their special car type lamps.

Leigh.—The Council has accepted the following tenders:—

A. Davidson & Co., induced draught apparatus	£300
Babcock & Wilcox, water-tube boiler and superheater	1,000
Chloride Electrical Storage Co., overhauling battery	390

North-Eastern Railway.—A contract has been placed with the Sunbeam Lamp Co. for the supply of electric lamps for the next six months.

Radcliffe.—The U.D.C. has accepted the tender of the Lorain Steel Co. for the supply of special tramway track work.

Royton.—The following tenders in connection with the electric tramways have been accepted by the U.D.C.:—

Wm. Underwood & Bros, Dukinfield, permanent way, £41,000.
Brush Electrical Engineering Co., Ltd., overhead equipment, £7,784.
Messrs. W. T. Glover & Co., Ltd., Manchester, cables, £5,636 14s. 2d.

Taunton.—The T.C. has accepted the offer of the Langdon-Davies Motor Co., Ltd., for the supply on a seven years' agreement of motors on the hire and hire-purchase systems.

Walthamstow.—The U.D.C. has accepted the tender of the British Westinghouse Electric and Manufacturing Co., at £21,137, for 32 tramcars and accessories.

Warrington.—The Electricity and Tramways Committee has accepted the tender of Mr. J. A. Ewart for the construction of the permanent way of the Stockton Heath tramway, at £2,936.

FORTHCOMING EVENTS.

Saturday, June 25th.—At 3 p.m. Junior Institution of Engineers. Visit to the Chelsea generating station of the Underground Electric Railways Co., Lot's Road, Chelsea.

Saturday, June 25th to July 2nd.—Colliery Exhibition at the Royal Agricultural Hall, Islington, N.

Monday, June 27th.—From 9 to 12 p.m. Annual conversazione of the Society of Arts at the Royal Botanic Gardens, Regent's Park, N.W. Reception by the chairman, Sir. W. Abney.

Tuesday, June 28th.—9 to 11.30 p.m. Conversazione of the Institution of Electrical Engineers at the Natural History Museum, Cromwell Road, S.W.

Wednesday, June 29th.—At 4 p.m. Annual general meeting of the Society of Arts.

Wednesday, June 29th to Saturday, July 2nd.—The Incorporated Municipal Electrical Association. Annual Convention at Derby, Nottingham and Sheffield.

Saturday, July 9th.—Junior Institution of Engineers. The visit to Dover to inspect the Admiralty Harbour Works, announced for Saturday July 2nd, has been postponed to Saturday, July 9th.

NOTES.

Smoke and Smell.—Engineers who are responsible for the operation of electric light and power plants—indeed, all who are open to the persecutions of the Smoke Abatement Society—will find an interesting contribution to the literature of the Nuisance question on page 1055 of this issue. The emission of black smoke has been the cause of many an anxious hour for some power station engineers, particularly in the neighbourhood of London, and much expenditure has been incurred for its prevention, but the possibilities before us in the shape of a Pure Smoke and Effluvia crusade are truly terrorising. Who knows but that the Smoke Abatement Society will have to change its name and add to its staff of officials a few men whose olfactory organs have reached the highest possible pitch of development!

The International Engineering Congress at St. Louis.—This Congress, which is to be held from October 3rd—8th, under the auspices of the American Society of Civil Engineers, will consider a multitude of papers covering every branch of engineering science and industry. We select the following announcements from the official list of subjects which is just to hand:—

"Traffic on Improved Waterways, &c.," by Edward P. North, New York City.
"Purification of Water for the Production of Steam," by James O. Handy, chief chemist, Pittsburg Testing Laboratory, Pittsburg, Pa.
"Turbines and Water Wheels," by Gardner S. Williams, Ithaca, N.Y.; and P. O. Lévy Salvador, Ingénieur des Constructions civiles, Ingénieur au Ministere de l'Agriculture, France.
"Railroad Terminals," by Elmer L. Corthell, New York City; W. T. Foxlee, London; and Ernest Pontzen, Ingénieur des Constructions civiles, France.
"Underground Railways," by William Barclay Parsons, chief engineer, Rapid Transit Comm., New York City; Basil Mott, and David Hay, Central London and City and South London Railways, England; and M. Blette, Ingénieur des Ponts et Chaussées, adjoint à l'Ingénieur en Chef du Chemin de fer Métropolitain de Paris, France.
"The Substitution of Electricity for Steam as a Motive Power," by James G. White, New York City; and Alexander Siemens, London.
"Ventilation of Tunnels," by Charles S. Churchill, chief engineer, Norfolk and Western R.R., Roanoke, Va.; and Francis Fox, London.
"Passenger Elevators," by Thomas E. Brown, New York City.
"Steam Turbines," by Francis Hodgkinson, Pittsburg, Pa.; and M. Rateau, Ingénieur des Mines, Professeur à l'Ecole des Mines, France.
"Electrical Power—Generating Stations and Transmission," by L. B. Stillwell, New York City.
"Engineering Education," by Robert Fletcher, Professor of Civil Engineering, Dartmouth College, Hanover, N.H.; Calvin M. Woodward, Dean of Eng. School, Washington University, St. Louis, Mo.; and W. Cawthorne Unwin, F.R.S., M.Inst.C.E., Cooper's Hill College and City and Guilds Technical College, London, England.

The Junior Institution of Engineers.—On Tuesday evening, June 14th, a visit of this Institution took place to the motor-car works of Messrs. D. Napier & Sons, Acton Vale. The next visits of the Institution take place on Saturday afternoon, June 25th, when the Chelsea generating station of the Underground Electric Railway and the L.C.C. pumping station in Lots Road are to be seen; and on Saturday, July 9th, an excursion is to be made to Dover. The new turbine steamer *The Queen*, the Admiralty Harbour Works, and the works of the Dover Harbour Board are included in the programme; and in the afternoon the Mayor and Mayoress of Dover receive the Institution at the Town Hall.

Tramway Running Powers.—The *Financial Times* says that a private meeting of members of Parliament was held on Tuesday night at the House of Commons to consider the action necessary to be taken with regard to the clauses in the Bill of the Tyneside Tramways Co. to grant compulsory powers over the Newcastle Corporation tramways. It is understood to have been agreed that, whatever settlement the parties might arrive at in such cases by mutual agreement, the principle of granting statutory powers to a private company over Corporation tramways should be resisted. One of the members present agreed, when the Bill comes up about a week hence, to move its recommittal upon the point in question.

The Civils' Conversazione.—The annual conversazione of the Institution of Civil Engineers was held on Wednesday and Thursday, June 15th and 16th, from 9 to 12 p.m. Sir Wm. White being President, a large show of naval models formed one of the features of the programme. There was a collection of pictures, including those belonging to the Institution, chiefly portraits, and a number on loan, notably five by J. M. W. Turner, R.A., lent by Sir Donald Currie. The evening was pleasantly diversified with song, under the direction of Mr. Robt. Hilton, and the string band of the Royal Artillery was also present in the hall below. The usual collection of models and scientific apparatus was there, including electric furnaces, an excess indicator, exhibited by Mr. C. W. Atkinson, and also a maximum demand indicator, both of these instruments being good examples of sound commercial instruments, made at a really low price by modern shop methods. There was an interesting model of the Yarrow hinged flap for ensuring solid water, round a partially immersed propeller, a most instructive exhibit. There were too many people crowded into a limited space to enable a full view of all models and apparatus to be obtained in the available time, but the evening was a pleasant one, and one met there all and sundry.

Third-Rail Fatalities.—Among last week's House of Commons questions, was one by Mr. Soares, asking whether the Board of Trade's attention had been called to the death of Patrick Flood, who was recently electrocuted on the Southport Railway through stepping on a live rail; whether the President would grant a return of the number of accidents which had happened up to the present time of a similar nature; and what steps did he propose to take in order to prevent the happening of such accidents. Mr. Gerald Balfour replied:—"A report of the accident has been rendered by the railway company. Two fatal and two non-fatal accidents of this character have occurred on the railway mentioned. The sufferers in each case were trespassers on the line. I have ordered an inquiry into the causes of the accident."

A further question was answered on June 20th. Mr. Bell asked whether his attention had been called to a recent fatal accident to a child at Jesmond, a fatal accident to Joseph Innes at the Manors Station on the 13th inst., an accident to James Hughes on the same date, and an accident to Philip Gilroy at the Newcastle central station on the 14th inst., all of them through coming in contact with the live rail on the electric section of the North-Eastern Railway; and whether he would consider what steps were necessary, and what means could be adopted, to protect such rail upon electric railways in existence and which might be constructed in future. Mr. Gerald Balfour, in reply, said:—"The Board of Trade have received information from the railway company in regard to each of these unfortunate accidents. I may mention that in the last-named case the injury appears to have been slight, not necessitating absence from duty. I have ordered an inquiry into the circumstances attending the fatal accident at Manors Station, and the report made by the Board's inspecting officer will receive careful consideration."

South African Notes (from our Durban correspondent):—*Kimberley* (*Cape Colony*).—In the recently issued report of the Kimberley Corporation for the year ending December 31st, 1903, the following figures are given in connection with the electricity department:—

Capital account—Expenditure	£36,983 15 5
Revenue from electric lighting..	£25,330 5 5
Expenditure " "	19,015 14 11
Credit balance	£6,314 10 6

The De Beers Co. are negotiating with the Kimberley Corporation for the equipment of an electric tram line to Alexandresfontein, about six miles from town, where the company have a large hotel.

East London (*Cape Colony*).—The East London Municipal accounts for the year ending February 29th, 1904, give the following figures for the electricity department:—

Electric light revenue	£16,200 1 10
" " expenses	13,000 14 8
Balance	£3,199 7 2
Tramway revenue	£15,093 0 2
" expenses	10,205 8 5
Balance	£4,887 11 9
Total balance	£8,086 18 11

Mr. A. G. Knight, of Port Elizabeth, has received the contract for the installation of electric lighting in the new Administrative offices of the Port Elizabeth Harbour Board.

Another correspondent says:—

Pietersburg.—At a meeting of the T.C., the General Purposes Committee reported that having considered the advisability of installing electric light, it recommended attention being given to the subject by the Council. The terms of a letter by Mr. Curtis regarding the employment of the Government electrical engineer were discussed, and it was decided to engage the engineer's services for the preparation of a preliminary report at a fee of five guineas, plus all expenses.

Durban.—The question of cranes at the Point was again discussed by the Port Advisory Board lately, and in the result was referred to committee, the general opinion being that all new works should be fitted with electric cranes.

The Kelvin Science School.—Those of our readers who appreciate the importance of a scientific education for boys will be interested to hear of the forthcoming opening, on June 29th, of the Kelvin Science School, at Trent College, Derbyshire. The school has been thus named by the special permission of Lord Kelvin, who is one of the subscribers to the building fund. The opening ceremony will be performed by Sir Douglas Fox, late President of the Institution of Civil Engineers. The Bishop of Liverpool has also promised to attend, and it is expected that there will be a large gathering of prominent scientific men and others who are interested in the progress of education.

London County Council.—At the meeting on Tuesday, it was decided to lend £28,589 to the Bermondsey Borough Council for the purposes of electric lighting and refuse destruction.

The Highways Committee reported that the load on the cables feeding the Clapham sub-station from the temporary generating station at Loughborough junction had proved to be in excess of that originally anticipated, with the result that at times there is a serious waste of energy. It was, therefore, suggested that additional cables, at a probable cost of £3,500, should be laid between the Loughborough station and the sub-station at Clapham. It was estimated that a saving of £1,300 a year would be effected in the cost of electrical energy by the adoption of the scheme, and the running of the cars between Tooting and Clapham would be materially improved. The Committee submitted a recommendation to this effect, and this was agreed to, the cables to be obtained from the British Insulated and Helsby Cables, Ltd.

The question of appointing a rolling stock superintendent, who would be responsible for the construction, maintenance and repair of the electrical rolling stock, was also referred to by the Highways Committee, who had come to the conclusion that an official should be specially engaged to undertake this work. A recommendation in this respect was submitted, the official to have a salary of £400 a year.

The Council postponed for a week the consideration of a report by the Highways Committee proposing an expenditure of £95,500 for the purchase of the undertaking of the London, Deptford and Greenwich Tramway Co., under the award of Mr. H. Graham Harris, the referee appointed by the Board of Trade for the purpose.

The St. Pancras Conference.—A decision was arrived at, at the concluding private sitting of the conference of local authorities owning electrical undertakings, recently held at St. Pancras, to send a petition to the President of the Board of Trade asking to have included in the Electric Lighting Bill, 1904, a clause to the following effect:—"All lands purchased by any local authority, company or person, by agreement, prior to the passing of this Act, and used by them for the purpose of a generating station, shall be deemed to have been purchased by them compulsorily for such purpose, and rules shall be made by the Board of Trade under Sec. 5 of the Electric Lighting Act, 1882, so as to exclude the application to any such lands of Sec. 31 of the Electric Lighting Clauses Act, 1899, or any similar provision in any existing Electric Lighting Order of a local authority, company or person."

Glasgow Tramway Accounts.—A draft of the report and financial statement in connection with the Corporation tramways for the year ending May 31st was submitted to the T.C. Committee on Wednesday. The general manager was instructed to have the audit completed.

Gross revenue		£724,851
Expenditure—		
Power	£20,293	
Traffic	197,362	
General	71,526	
Repairs	67,495	
	£356,676	
Set aside for renewal and depreciation	139,644	496,320
		£228,531
Rent of Govan lines	£5,068	
Interest	59,308	
Sinking fund	45,553	
Parliamentary expenses	12,865	
Common good	25,000	147,794
Balance		£80,737

The Committee propose to appropriate £62,000 of this sum to special depreciation, and to carry the balance to reserve fund.

The Printing Trades Exhibition.—With reference to the notice on page 991 of our last issue, we understand that the Electromotor and Dynamo Co. received a silver medal and first-class certificate, also a bronze medal, for their exhibits. We mentioned the bronze medal only last week, through incomplete information.

Appointments Vacant.—The Council of Birmingham University is inviting applications for a Chair of Electrical Engineering, which carries a stipend of £1,000 and liberty to undertake a certain amount of consulting work; Maidstone Light Railways Committee want a man for their car repairs department (35s.); junior assistants for the Newcastle-upon-Tyne Electric Supply Co.; borough electrical engineer for Limerick (£160).

The American Visit of the Institution of Electrical Engineers.—Mr. Calvin W. Rice and Mr. R. W. Pope, the organising honorary secretaries of the American visit of the Electrical Engineers, are apparently leaving nothing undone towards ensuring a most hospitable welcome to the members on their arrival in the States. We are informed that a large contingent of the Italian Electrical Society have made arrangements to participate in

the tour, and these will meet the representatives of the British Institution on their arrival at Boston. The official reception of the party is to take place at the Waldorf-Astoria Hotel, New York, on the evening of September 5th, on which occasion all the visiting members will be the guests of the American Institute of Electrical Engineers. In view of the anticipated large number of distinguished guests from the United Kingdom and Italy, the American Institute is sparing no pains to make this a most complete and memorable trip, and everything is being done to ensure the comfort and convenience of the members throughout the journey.

Electrical Ore Finding.—In the paper read by Mr. Alfred Williams at the demonstration to which we recently referred, he mentions that systems of ore-finding depending upon measurements of the resistance between portable electrodes are bound to fail, as, in the course of such measurements which he has carried out over 150 lodes, he has never found a variation in the earth resistance caused by the ore body.

Sir W. H. Preece's experiments, some 20 years ago, with interrupted currents and telephone receivers led to the development of the Daft-Williams system, which has been gradually perfected during the last five or six years. The transmitting electrodes are usually earthed at a distance of about 100 yards apart, and the telephone receivers, connected with electrodes about 70 ft. apart, give an audible note at least a mile away, while, with a longer base, and receiving electrodes 150 ft. apart, signals can be received 2 miles away, the power expended being 100 watts. Generally a radius of ½ mile is sufficient. It will be understood that deposits of ore are usually found in comparatively thin but very deep lodes, which, if conducting, change the intensity of the sounds heard in the telephone in a remarkable manner, there being a considerable increase in the intensity in the vicinity of the apex of the lode. When the electrodes are equidistant from the lode, on either side of it, no sound, or at any rate very little, is heard in the receivers. On the other hand, if the lode is of a non-conducting character, loud sounds are heard in the receivers when the electrodes are on either side of the lode. When tracing the course of a known conducting lode, one electrode is earthed in the lode itself, and the other at some distance from it. The lode can then be traced with ease. Where the lode is non-conducting, both transmitting electrodes are earthed on one side of it. The lode then forms a sharp boundary to the electric field, and is readily localised. Similarly, the author describes the method of dealing with a faulted lode, in order to pick up the unknown portions of it.

The first experiments were made in Alaska in 1899, on a copper lode, which was believed to follow a certain direction, but was indicated by the electrical apparatus in a quite different position; when the lode was developed it was found where the ore-finder had shown these indications. Instances of other successful prospects carried out on Prince of Wales Island, at Cwmystwyth, Alston Moor, Cleator Moor, in Western Australia, Siberia, &c., are given, the ores localised including copper, galena, haematite, gold-bearing quartz, &c. Evidently, when in capable hands, and, as Dr. Thompson says, when not expected to perform miracles, the electrical system of ore-finding should prove of great practical value, and add another jewel to the crown of the goddess Electra.

Large Order for Cables.—An order for no less than 1,500 miles of bare copper cable, weighing about 4,200,000 lbs., has been placed with the Ansonia Brass and Copper Co., of New York. According to the *Electrical World and Engineer*, the cable is to be used on the Nicaxia-Mexico power transmission line, and will be carried in spans of 500 ft. on steel towers. The cable is of special design, the invention of Mr. W. G. Clark, of Seattle, consisting of six wires laid up round a soft compressible core. This ensures the uniform stressing of all the wires when the cable is suspended, and renders it more flexible and easy to handle; the core may decay away after erection, without detriment to the cable. The drums on which the cable will be shipped, if piled flat one upon another, would make a column nearly 1½ miles high.

Electrical Driving of Machines. — Discussing the question of individual or group driving of tools, Mr. R. E. Buck accepts the claim that when machines are near each other it does not pay to drive them independently, unless the size of each motor is required to be at least 3½ H.P. Below this power first cost and interest outweigh other advantages, for each machine driven independently must have a maximum power motor, whereas the motor which drives a group need not be of more than half the aggregate power of the whole number of driven machines. To drive short straight well-erected shafting is less costly than the various expenses connected with inefficient small motors.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Norwich Electricity Committee recommended that a grant of £80 be made to Mr. F. M. LONG, the city electrical engineer, to enable him to visit the St. Louis Exhibition.

Mr. JOHN HENDERSON MACKAIL, A.M.I.E.E., A.M.I.Mech.E. mains assistant to the Charing Cross and Strand Electricity Supply Corporation, has been appointed electrical engineer to the Municipal Commissioners of Singapore.

The Edinburgh Town Council has increased salaries in the electric lighting department as follows:—Chief assistant engineer, from £350 to £375 per annum; station engineers (5), from £160 to £200; second assistant to superintendent of mains, from £120 to £160; superintendent of meters, from £250 to £275; clerical assistant to engineer, from £200 to £220; and assistant clerk, from £110 to £120 per annum.

Mr. EDWIN SEDDON, now shift engineer at the Hanley Corporation electricity works, has been appointed shift engineer at the Eastbourne works. There were 67 applications for the post.

Mr. G. H. SAUNDERS, formerly of the Taunton Corporation electricity works, who was appointed by the Loughborough Corporation to take charge of their temporary electricity works, has now been appointed by that corporation to superintend the erection of plant at their permanent station.

By 8 votes to 4 the Falkirk Council on Monday granted an advance of salary to the electrical engineer, Mr. JOHN MCMILLAN, from £200 to £230.

The Bath Electric Lighting Committee recommends that the salary of Mr. TEAGUE be increased to £550 for one year from April 1st last, and that in the event of the undertaking continuing to make satisfactory progress, a further increase to £600 per annum be made. Increases of the salaries of Mr. F. HALE, station superintendent, of Mr. C. S. WALKER, shift engineer, Mr. D. T. MILES, mains superintendent, Mr. NETHERCOT, and Mr. SHAPLEY are also proposed.

Electric Tramway Officials.—Bolton Tramways Committee has out of 224 candidates selected Mr. F. TAYLOR, of Bury (Lancs.) for the post of assistant tramways engineer. Mr. Taylor is in the service of the Westinghouse Co., Manchester, and was previously connected with the Coventry and Madrid Tramways.

General.—A few weeks ago we referred briefly to the death of MR. ARTHUR LE NEVE FOSTER. We are now able to supplement that notice with a few further references to the deceased gentleman's career. When a lad Mr. Foster served his time at the engineering works of the South-Eastern Railway Co., at Ashford, and on leaving there was for some time with Messrs. Easton and Amos, noted pump-makers. In 1864 he was appointed chief engineer to Prince Halim Pasha, and for several years managed his engineering works, cotton and agricultural machinery, and irrigation works at Kaffi Shaik and Shubia, in Lower Egypt. Leaving there in 1871 he was appointed chief of the Egyptian Government Telegraphs. In 1874 he returned to England, and became head of the electrical department of the India-Rubber & Gutta-Percha Co., Ltd., at Silvertown, and superintended the laying of cables in South America and elsewhere. In 1888 he joined Messrs. Davis and Timmins, Ltd., and up to his death was managing director of that firm. He did valuable work as a member of the "Engineering Standards Committee" appointed by the British Association, being especially concerned with "Screw Treads and Limit Gauges." He was a member of the Automobile Club and the Thatched House Club.

The members of the staff and employés of the Sunbeam Lamp Co. foregathered, at the invitation of the managing director (Mr. J. W. Edmundson) and his wife, at the Co-operative Hall, Gateshead, on Friday evening last, to meet Mr. and Mrs. HERBERT EDMUNDSON and Mr. and Mrs. LAURENCE RICHARDSON, who had been joined in parallel (or series, if you will). Mr. Edmundson welcomed the guests to partake of his hospitality as marking the double event in his family, his daughter, Miss Edmundson, having recently become Mrs. Richardson, and her brother, the assistant manager at the works, having taken unto himself Miss Harrison, from the "Tree of Knowledge" (Braintree), Essex. The conversazione proved a great success. Harmony was provided by the guests and friends, and there was abundant evidence throughout the proceedings of very cordial relations existing between employers and employed. The indefatigable secretary, Mr. T. J. Grainger, in "switching off" the exuberance, tendered thanks to the conveners, and asked on behalf of all present the acceptance of their best wishes for a bright future for the newly-wed.

Brighton T.C. has increased the salary of Mr. GARDNER, assistant telephone manager, from £130 to £140 per annum, with an annual increase of £10 up to £200. The staff is to receive a commission of 2s. for each £5 10s. order secured.

Mr. E. E. STOCKENS, district manager at Canterbury of the National Co., on leaving for Aberdeen, has been presented by the staff with a gold chain. Mr. Wolstenholm, of Leeds, succeeds Mr. Stockens at Canterbury.

On the 15th inst. at St. Thomas's Church, St. Anne's-on-the-Sea, Lancashire, Mr. W. A. L. MASSEY, of W. T. Henley's Telegraph Works Co., Ltd., of London, was married to Elizabeth, daughter of Mr. S. Pullan, of Preston and St. Anne's-on-the-Sea.

Mr. J. IRVING COURTENAY, the Chairman of the United River Plate Telephone Co., will next month proceed on a visit to the company's system in River Plate, with a view to getting into closer touch with the staff and undertaking, with which he has been so long and so successfully associated in this country.

The employés of the National Electric Construction Co., Ltd., Wolverhampton and Wednesbury, have presented a wrought-iron curb with copper ornaments and fire-irons to Mr. ALLEN R. CONNAL, district manager at Wednesbury, on the occasion of his marriage.

Mr. H. CARLISLE, A.I.E.E., the Eastern Telegraph Co.'s representative at Durban, Natal, having qualified for a retiring pension, severs his connection with the company at the end of July, after representing them as superintendent for about a quarter of a century.

Mr. J. Leopold Harris, A.M.I.E.E., who was till lately connected with the Bastian Meter Co, Ltd., has now opened offices at 165, Queen Victoria Street, E.C., where he will specialise in everything appertaining to the work of a publicity department. He will still retain his connection with the Bastian Meter Co. with regard to Scheeffer meters for alternating currents, and will also handle other specialities.

NEW COMPANY REGISTERED.

Gratze Patents and Engineering Syndicate, Ltd. (81,236).—This company was registered on June 14th, with a capital of £5,000 in £1 shares, to carry on the business of manufacturers and repairers of and dealers in magnetic or other speed indicators, pressure and speed gauges, magnetic and electric apparatus, &c., and to adopt an agreement with E. V. Gratze and W. T. Oades. The first subscribers (each with one share) are:—E. E. Brown, 10, Upper Park Road, Hampstead, N., solicitor; A. F. Harvey, 11, Pancras Lane, E.C., solicitor; W. S. Webb, 120, Barry Road, East Dulwich, S.E., clerk; S. Cole, 9 and 10, Pancras Lane, E.C., chartered accountant; C. A. Bayley, 10, Montague Avenue, Brockley, clerk; P. C. Page, 12, Dulberg Road, Brixton, clerk; and F. F. C. Webb, 11, Pancras Lane, E.C., solicitor. No inititial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; remuneration, 10 per cent. of the net profits, divisible.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Browett, Lindley & Co., Ltd. (63,128).—This company's annual return was filed on April 16th, when 50,000 preference and 50,000 ordinary shares had been taken up out of a nominal capital of £120,000 in 60,000 preference and 60,000 ordinary shares of £1 each. £1 per share has been called up and paid on 42,000 preference and 23,478 ordinary. 34,522 shares are considered as fully paid. Mortgages and charges: £30,000 debenture stock.

Vaughan, Brown & Co., Ltd., electrical engineers, London (80,142).—A debenture, dated May 21st, 1904, to secure £250, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: T. W. Vaughan, 21, Lloyd Square, W.C.

Northern Counties Electricity Supply Co., Ltd. (67,924).—Issue, on June 3rd, of a mortgage debenture for £5,000, part of series created February 18th, 1904, to secure £100,000, charged on the company's undertaking and property, present and future, except uncalled capital. Holders: T. E. Hodgkin and J. W. B. Pease, Collingwood Street, Newcastle. No trustees. Previously issued of same series: £20,600.

Severn Electric Launch Co., Ltd., Stourport (75,772).—£400 first mortgage debentures, created February 27th, 1904, and dated May 25th, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Perth Electric Tramways, Ltd. (55,935).—A trust deed, dated December 30th, to secure £50,000 debentures, created December 22nd, 1903, have been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: Lord Arthur Butler, 7, Portman Square, W.; and J. S. Austen, 68, Dashwood House, E.C.

H. Fraser & Co., Ltd., gas and electric appliance dealers, London (80,884).—£1,000 mortgage debentures, created June 8th, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. No trustees.

Globe Telegraph and Trust Co., Ltd. (7,465).—This company's annual return was filed on June 7th, when 180,877 preference and 120,877 ordinary shares had been taken up out of a nominal capital of £5,000,000 in 250,000 preference and 250,000 ordinary shares of £10 each. £10 per share has been nominally called up on 46,009 shares, resulting in the receipt of £433,115 8s. £3,167,450 is considered as paid on 316,745 shares. Mortgages and charges: Nil. (Certain shares were issued at a discount prior to 1885, and the company is now stopped from denying that the same are fully paid.)

CITY NOTES.

United River Plate Telephone Co.

Mr. J. Irving Courtenay presided at the meeting of this company held at Winchester House on Tuesday, and in moving the adoption of the report (see Electrical Review, June 17th), he said that for several years he had had the pleasure of stating the satisfactory progress of the business in Argentina, which, from its inception, and through both good and evil report in regard to that country, had shown constant improvement and advance. That there had also been an increase in the rate of dividend was a tangible and convincing proof of their improved condition. The board had always been, and would remain, conservative in the matter of dividend payments. Argentina was advancing in every direction, and this company naturally expected to share in that prosperity. In order to do so, they had already been preparing to a certain extent for future business. The acquiring of central office properties and underground plant expenditure were steps in that direction, as were also line extensions and new exchanges, which were being demanded in the more important towns throughout the republic. The subscribers had increased by 800 during the year ended last March, and the improvement for the following two months was at a still higher rate, and was expected to be maintained at a similar proportion for some time. The advantages of the underground system and improved exchange equipment were now beginning to tell. A sum of £10,000 had been put aside for renewal of plant, while a further £15,000 was being added to the reserve fund, now standing at £95,000. The additional capital outlay for the year was £48,925. A considerable portion of this had been required in connection with the new subscribers, in addition to which there had been, as there would continue to be, large expenditure on underground plant and the extension of lines in the provinces. The receipts in the River Plate showed the substantial increase of £10,350, while maintenance charges and general expenses were but £1,588 heavier, a most gratifying result. The final position was an available sum of £7,600 more than a year ago, and after adding substantially to the reserves for renewal of plant and other contingencies, the directors were able to recommend the increased dividend on the ordinary shares of 8 per cent. To a considerable extent the demand for capital outlays had so far been met from the company's reserves, and to some extent they would doubtless be thus met in the future, but the large expenditure to be expected would necessitate further capital issues, from which adequate returns might reasonably be expected. In preparation for this they were asking permission to make such fresh issues of shares as might be considered from time to time most convenient and desirable. At present an issue of £60,000 appeared to be all that was necessary. It seemed hardly advisable to go to the general public with so small an issue, and it had been decided to offer it to the holders of ordinary shares at par.

The adoption of the report was seconded by Mr. Frank W. Jones, the managing director, and carried unanimously.

The retiring directors and auditors having been re-elected, the Chairman proposed the resolution increasing the capital from £500,000 to £1,000,000 by the creation of 100,000 new shares of £5 each. This was carried unanimously. Votes of thanks to the staff and officials abroad, and to the directors, closed the meeting.

R. Waywood & Co.

This company recently held its meeting at Cannon Street Hotel, Mr. Hy. C. Walker presiding.

In moving the adoption of the report, the Chairman said that though trade generally had been depressed, the company had had another very satisfactory year. The tonnage sent out from the works was larger than it had ever been, but they had had to do a larger volume of business to earn the same profit as in the previous year. It was difficult to compare the balance-sheet with that of the preceding year, because other accounts were included, but since then the directors had carried through the wishes of the shareholders, and a separation had been effected between R. Waygood & Co., Ltd., and the Otis Elevator Co., Ltd., so that the two are now carried on separately, as two distinct companies. The result had proved the wisdom of the step. They had completed the purchase of the freehold of the foundry at Coventry. The profit on trading amounted to £55,263, against £68,858 last year, which included the Otis, but if compared with the previous year of R. Waygood & Co., Ltd., it showed a substantial increase. The balance carried down amounted to £19,744. They recommended that while pursuing the safe course of increasing the reserves and making proper provision for depreciation and other contingencies, a dividend should be declared at the same rate as last year—namely, 13 per cent. per annum—for the six months ending March, making, with the interim dividend of 5 per cent. already paid, 9 per cent. for the year. A balance of £6,074 1s. 9d. was carried forward. There had been a good deal of controversy lately as to the relative advantages of electric and hydraulic lifts, and while the number of electric lifts and hoists erected by the company during the past year had much increased, they had manufactured and erected very nearly as many hydraulics as they did a few years ago, when they were doing scarcely any electrics.

Mr. R. Percy Sellon seconded the motion, and it was carried.

Buenos Ayres Grand National Tramways Co.

Mr. N. G. Burch presided at the meeting of this company, held at St. George's House, Eastcheap. He stated that the number of passengers carried on the Grand National Nueva system increased from 22,000,000 to about 23,500,000. They might confidently expect a considerably greater increase when they had electrified their system. In December last, says the *Times* report, they obtained concessions from the municipality for the electrification of the joint system, the terms being identical for both companies. The directors lost no time, when the concessions were obtained, in raising the necessary funds for giving a prompt start to the works. Having at their back financial groups of great influence and importance, they were signally successful in raising funds to embark upon the electrification, and when they decided to make the issue of half the capital involved in the first instance, they were able to place the whole of the bonds of that issue without having to resort to a public prospectus. They immediately proceeded to organise a local committee to carry out the work, and he had little doubt that that local organisation would see that it was conducted in the most efficient, economical, and satisfactory way. The whole of the materials for the first half of their system had been ordered upon very favourable terms. The work of preparation for the laying of the track in Buenos Ayres was now actively proceeding, and he believed that before they met next year they would have reached that great landmark in their history when 30 miles of the line would have been electrified, and when they would come under new conditions as to the pooling arrangement with the Nueva Co.

Electric and General Investment Co.

The directors' report for the year ended May 31st, 1904, reads as follows:—

The profit and loss account shows a gross profit on the transactions of the year of £15,804 7s. 8d. After deducting all general charges and the interim dividends already paid on the preference and ordinary shares, and providing for the proportion of the final dividend accrued on the preference shares to May 31st, 1904, there remains a net balance of £6,813 17s. 9d. Out of this amount, the directors recommend that a dividend of 1s. per share, absorbing £1,000, be declared on the ordinary shares, making, with the interim dividend, 10 per cent. for the year on the capital paid up thereon. In view of the present depreciation in the market values of the investments held by the company, the directors propose to place the balance of £5,813 17s. to 9d. to the "Provision for contingencies," raising that fund to £41,575 18s. 7d., which the directors consider to be an ample provision. The trustees for the founders' shares reserve fund propose to distribute to the holders of such shares a sum of £10 per share. [The above-mentioned payments will be subject to the deduction of income-tax.]

Prospectus.—This week the BIRMINGHAM AND MIDLAND TRAMWAYS, LTD., has been before the public with an issue of £200,000 4½ per cent. first debenture stock. The price of issue is 97 per cent., and the stock is redeemable at 105. The Electric and General Investment Co., Ltd., are trustees for the debenture holders. The company has a paid-up share capital of £909,780. It has shares and debentures of £633,122 in the City of Birmingham Tramways Co., Dudley, Stourbridge and District Electric Traction Co., South Staffordshire Tramways (Lessee) Co., and the Wolverhampton District Electric Tramways; it also has certain other investments, &c., bringing up the total assets to £1,103,869. The electrification of the company's lines is now proceeding. The company's net income last year was £44,128, but the present issue of debentures only requires £9,000 in respect of interest. The objects of the issue are the repayment of temporary loans, defraying the further cost of works in hand, and for general purposes. The list of subscriptions was to close on Wednesday this week.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in, and to grant a quotation to:—

Anglo-Argentine Tramways Co., Ltd.—120,000 ordinary shares of £5 each, fully paid.

Also to appoint a special settling day in:—

Rhodes Electrical Manufacturing Co., Ltd.—6,135 ordinary shares of £1 each, fully paid, Nos. 35,001 to 41,000 and 43,101 to 43,235; and 38,000 vendors' ordinary shares of £1 each, fully paid, Nos. 1 to 35,000, 41,001 to 43,100 and 43,236 to 44,135.

The Committee has further been asked to allow the following securities to be quoted in the official list:—

British Electric Traction Co., Ltd.—Further issue of 1,235 ordinary shares of £10 each, fully paid, Nos. 232,067 to 233,301.

The Committee has ordered the undermentioned securities to be quoted in the official list:—

Potteries Electric Traction Co., Ltd.—Further issue of 2,500 5 per cent. cumulative preference shares of £10 each, fully paid. Nos. 42,001 to 44,500; and 2,500 ordinary shares of £10 each, fully paid, Nos. 52,001 to 54,500.

Underground Electric Railways Co. of London, Ltd.—£3,599,200 5 per cent. profit-sharing secured notes, Nos. A1 to A8,450 of £100, B8,451 to B9,561 of £200, C9,562 to C10,385 of £500, and D10,386 to D12,480 of £1,000 each, in lieu of the fully paid provisional certificates now quoted.

West African Telegraph Co.—The Marquis of Tweeddale presided at the company's meeting, held on 16th inst. at Electra House. The report showed that the gross revenue for 1903 amounted to £62,514, including £1,321 for interest on reserve fund. The gross revenue was £61,193 against £70,399. The decrease (£9,206) was due to the readjustment of the proportions of the South African joint purse, of which they now received a smaller share than heretofore, and also to the loss of traffic with the French stations which had been taken over by the French Government under the arrangement explained at the last meeting. It was difficult to attempt any comparison of the expenses between the period under review and the preceding 12 months, as the withdrawal of the French stations from the system had caused a reduction in the items of expenditure under practically every head. The sum transferred to reserve was large, but not too large, having regard to the age of the cables, to the prospective termination of the Portuguese guarantee, and to the company's obligations under the agreement with the French Government. Sir H. Mance seconded the motion, and it was carried.

Thomas Parker, Ltd.—The directors have resolved to carry forward to next year's account the available balance of £1,410 after writing off the usual depreciations.

STOCKS AND SHARES.

Wednesday Evening.

MATTERS in the Stock Exchange have been very slow indeed since we last wrote. Every department complains unceasingly of bad business, and the summer lassitude seems to be settling down over all the markets. When extempore cricket matches and tennis sets take the place of movements in prices, no other sign need be asked to convince the outsider that the Stock Exchange is more idle than ever. For all that, several fresh Corporation Loans are rumoured as being on the point of appearance, and in view of the development of municipal enterprise in electrical tramway and similar directions, it is not difficult to surmise that there are still many local bodies eagerly watching an opportunity to raise money. The Bank Rate appears to be likely to remain at 3 per cent. until the turn of the half-year, after which a drop to 2½ per cent. is generally expected.

Railway stocks, as a whole, are dull, the approach of the dividend-time failing to save weakness throughout the list. Central London Deferred has given way a full 4 points to 80½ upon the usual cause—fear lest District electrified competition may jeopardise the dividend for a while. But Districts are steady at 38½, thanks to the Park Royal show and the success of the Earl's Court Exhibition. Metropolitan Consolidated has given way 1 to 97. Great Northern and City Preferred "A" shares are 5½, Great Northern, Brompton, and Piccadilly Ordinary 9½, and East London stock is 5. Business was marked last Tuesday in Underground Electric Railways of London 5 per cent. profit-sharing notes at 96⅞. We wonder why these portentously-named securities appear under the heading of "Commercial, Industrial, &c." in the Stock Exchange Official List?

After Lord Stanley's important announcement that the Government will waive the right to compulsorily acquire the National Telephone Co's. undertaking, it is somewhat noteworthy that the only price fluctuations should be confined to a point fall and rise in the Deferred and 3½ per cent. Debenture stocks respectively. The former is now 86½, and the 3½ per cent. Debenture has reached par, while the new 4 per cent. Debenture remains steadily at 5 premium over the issue price of 95, and the partly-paid stock is quoted 30.

Telegraph varieties are pretty much the same as they were a week ago. Anglo-American Ordinary, little dealt in as a rule, shows a point drop at 48½, but the more marketable Preferred and Deferred do not change. The Eastern group is motionless. Western Telegraph Debentures of both kinds are 1 per cent. higher, and West India Preference ¼ better at 6¼. With that the list of alterations comes to an end. Globe Ordinary are being done at 9, and the Preference are 13½. Submarine Cables Trust certificates remain firm at 120. British Insulated and Helsby Preference has hardened ¼ to 5⅞, while India-rubber shares are unaffected by the dividend announcement, which we mentioned last week.

Fair-sized parcels of electric lighting shares continue to change hands. We hear of 1,000 shares in this, and 2,000 shares in that, company being transferred, yet the quotations rarely move. Brompton and Kensingtons are being quietly absorbed, and the price is ¼ better at 11. An improvement of 10s. has taken Notting Hill shares to 13½, the proprietors evidently harbouring no apprehensions by reason of the Napoleon of the borough whom the booksellers are advertising. Smithfields are down ¼ to 3, after being a steady market for months. At 6⅞, Charing Cross new Ordinary keep about £1 beneath the price of the senior issue. The Blackheath and Greenwich trio is unchanged, nor is there any movement to report in Metropolitan Electric Supply stocks and shares. Edmundsons' Debenture is harder at 107½, and there is not much more of the new Urban Debenture still on offer at 98.

Further support has helped the British Westinghouse recovery, and the price is now 3⅝, the Debenture being 88½. Thomson-Houston Debenture is 102, and London United Tramways Debenture has hardened a point to 105. Metropolitan Electric Tramways Deferred are down to 2s. 9d., and the Preference to 18s., although the lines are said to be nearing electrification. Several of the lesser-known Debentures have begun to edge their way into investors' favour. Auckland 5 per cent. Debenture is now 1 per cent. over par, and Colombo Electric Tramways and Lighting 5 per cent. Debenture is 101-102. Anglo-Argentine Debenture, the despair of intending buyers, has been put up a trifle to 134½, but no stock is thereby attracted to market. The Ordinary shares keep steady at 6 and the Preference at 5½. A certain amount of trade in Buenos Ayres and Belgrano finds the Ordinary better at 3, and the "A" Preference 5½. British Electric Traction has sunk back ¼ to 10. The Second Debenture stock is dull at 97; possibly the little "pool" has been recently dissolved. The five stocks of the British Columbia Electric Railway are good, and the 4½ per cent. Vancouver Power Debentures have attracted attention at about par. Calcutta Trams are 7¼, Dublin United 13, Potteries Electric Traction 8½, and New General Tractions 1½—the last being a very nominal price. Cape Electrics are ⅛ off at 2 middle, which appears to represent about the proper value for the shares at the present time.

Babcock & Wilcox Ordinary shares stand on a level with Willans and Robinson Ordinary at 3, although, of course, the nominal values of the shares are £1 and £5 respectively. The founders' shares in the Electric and General Investment Co. are about to receive £10 per share dividend, drawn from the reserve fund attaching to these shares. At one time the price stood at about £400 per share. The recent issue of Birmingham and Midland Debenture has, we shrewdly suspect, left the underwriters with a very fair proportion of stock on their hands.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations June 15th.	Closing Quotations June 22nd.	Business done week ended June 22nd, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —103	99 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	70 —80	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	48 — 51	47 — 50	47½	47
3,105,680	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	91 — 93	92½	91⅝
3,105,680	Do. do. do. Deferred	Stock	2s.	1/-	2s.	6⅝— 7⅛	6⅝— 7⅛	7	6⅝
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	..	4⅞— 5⅛	4⅞— 5⅛	5⅛	5 3/32
13,333,300$	Commercial Cable	$100	8 %	8 %	..	175 —185	175 —185	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 96	95½	91½
16,000	Cuba Telegraph	10	4 %	6¼%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,981	Direct Spanish Telegraph	..	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	£50	..	..	..	100 —103⅝	100 —103	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10 — 10¼	10 — 10¼	10¼	10 1/8
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —103	100 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	126 —131	126 —131	130½	128⅝
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	89½	89
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106½	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11⅜— 12⅛	11⅜— 12⅛	11⅞	..
890,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	106½	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 3,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	8⅞— 9⅛	8⅞— 9⅛	9	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	13 — 13½	13 — 13½	13 7/16	13
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25 — 26	25 — 26	25½	..
58,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —103	100 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	42 — 45	44½	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	105	104
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	86 — 89	85 — 88	88	86
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	5 1/8	5 1/8
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98 — 100	99 — 101	..	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104½	104
1,000,000	Do. do. Prov. Certs., 70 % to be paid	..	..	..	..	29 — 31	29 — 31	30½	..
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	1⅜— 1 7/16	1⅜— 1 7/16	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	1⅛	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6½— 7½ xd	6½— 7½ xd	7½	..
3,808	Submarine Cables Trust	Cert.	..	..	..	117 —122	117 —122	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6¼	6 — 6¼	6⅛	6 7/32
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	5 1/32	5 1/32
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	97 —100	97 —100	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 307,980	10	7 %	7 %	7 %	12⅜— 13½	12⅜— 13⅜	13 1/16	12⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1908	100	..	..	..	101 —104	102 —105	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100 —103	101 —104	..	..
88,321	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	⅜	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	5½— 6½	6 — 6½	6¼	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	102	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	90 — 95	90 — 95	..	..
100,000	British Electric Traction	10	9 %	8 %	..	10 — 10¼	9⅞— 10⅛	10	9⅝
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10⅜— 11⅛	10⅜— 11⅛	10⅝	10⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	116 —119	116 —119	117½	116½
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅛— 6	5⅛— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —105	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅜— ½	⅜— ½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— 1	½— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1⅜— 1½	1⅜— 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 — 99	96 — 99	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	78 — 78	78 — 78	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9¼— 10⅛	7¼— 10⅛	10	..
40,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5⅛— 5⅜	..	..
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	104 —108	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	92 — 95	92 — 95	94	93⅛
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	102 —105	102 —105	104⅜	102½
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	83 — 86	79 — 82	82	79½
1,330,000	City and South London Railway	Stock	2 %	3½%	2¾%	50 — 52	50 — 52	51½	50½
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1⅜— 2⅛	1⅜— 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	95 — 98	95 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	¼— ⅜	¼— ⅜	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	⅜— 1½	⅜— 1½	..	..
44,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	78 — 78	78 — 78	..	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 79	75 — 79	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅜— 1⅝	1⅜— 1⅝	1⅛	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2¼— 2⅜	2¼— 2⅜	2⅜	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¼— 9⅜	9¼— 9⅜	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11⅛— 12⅛	11⅛— 12⅛	12⅜	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	19 — 20	19	..
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	100⅝	100⅝
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3¾— 4	3¾— 4	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	36 — 39	36 — 39	38½	37½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	89 — 92	89 — 92	90½	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st, 1904

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME,	Stock or Share.	Dividends for the last three years			Closing Quotations June 15th.	Closing Quotations June 22nd.	Business done week ended June 22nd, 1904.	
		‡	1901.	1902.	1903.			Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	⅜— ⅞	⅜— ⅞	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛— 1¼	1⅛— 1¼	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	120 —125	120 —125	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10½ — 11	10⅝ — 11⅛	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10½ — 10⅝	10⅛ — 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	105½	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7½ — 8	7½ — 8	7¾	6¾
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5½ — 5⅝	5½ — 5⅝	5⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½ — 5	4½ — 5	..	..
40,000	Do. do. 1903	5	..	..	..	4½ — 5	4½ — 5	4⅝	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104 xd	102 —104 xd	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5⅓%	6½ — 6⅔	6½ — 6⅔	6⅝	6½
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	11— 11½	11 — 11½	11⅝	11⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	13⅜	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	123½	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —104	102 —105	104	102½
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7½— 8½	7½— 8½	7⅞	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11 — 12	11 — 12	11⅞	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	106 —109	106 —109	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	100 —103	100 —103	101½	..
60,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅝— 6	5⅝— 6	5⅝	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	106 —109	107½	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12½	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1½— 1⅝	1½— 1⅝	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	5⅜	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	93 — 96 xd	93 — 96 xd	94½	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¼%	7½%	8⅓%	19½— 20½	19½— 20½	20⅛	20
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	5⅛
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	..	..	..	..	109 —113	109 —113	..	..
250,000‡	Do. do. 5½% Mort. Deb. Stock Red ..	Stock	..	..	..	97 —100	97 —100	99	..
10,853	Notting Hill Electric Lighting	10	6 %	6 %	6 %	12½— 13½	13½— 14½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅓%	14⅓%	14⅓%	14 — 15	14 — 15	14⅜	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 5½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	3 — 3½	2⅞— 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	1½%	3 %	3⅞— 4⅛	3⅞— 4⅛	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4½ — 5	4½ — 5	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4½ — 5	4½ — 5	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12½ — 13½	12½ — 13½	13⅛	12⅞
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6½ — 6¾	6½ — 6¾	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, June 22nd.

CHEMICALS, &c.		Price.	Week Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£21 10	..
a Lead, Nitrate	per ton	£34	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£97 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% s 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	5d.	..
a ,, Caustic (76/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£25	..
a Shellac	per cwt.	230/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£5	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£180	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6½d.	..
c ,, Tube (brazed)	per lb.	8½d.	..
c ,, ,, (solid drawn)	per lb.	7½d.	..
c ,, Wire, basis	per lb.	6½d.	..
c Copper Tubes (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn)	per lb.	8½d.	..
c Copper Bars (best selected ..	per ton	£69	..

METALS, &c. (continued).		Price.	Week's Dec. or Inc
g Copper Sheet	per ton	£69	..
g ,, Rod	per ton	£69	..
e ,, (Electrolytic) Bars ..	per ton	£62	..
e ,, ,, Sheets ..	per ton	£78	..
e ,, ,, Rod ..	per ton	£72	..
e ,, ,, H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/8 to 4/8½	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	42/7	2d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 15 to £11 17 6	..
g ,, ,, Sheet	per ton	£11 17s. 6d.	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£9	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/6	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
e Platinum	per oz.	£4	..
e Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£118 10 to £119 10	£2 10 dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6½	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
f Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
f ,, 6 les. Flax	per lb.	5½d.	..
f ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
f ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
f ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£25 5	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co.; f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week.		No. wks.	Total to date.		Miles open.	
		£	£*		£	£*		*
Aberdeen	June 18	1,502	+348	3	4,486	+ 870	10	—
Birmingham ..	,, 18	5,653	+920	25	132,892	+ 8,194	8½	—
Bournemouth ..	,, 15	1,019	+ 194	11	12,113	—	10½	—
Blackburn	,, 17	1,046	+309	12	11,460	+ 869	13½	—
Blackpool	,, 16	793	+ 19	11	9,577	+ 656	8½	—
,, —Fleetw'd	,, 18	559	— 94	25	8,774	— 777	7½	—
,, —Lytham	,, 16	791	+ 69	23	7,749	+ 5,668	7½	—
Bolton	,, 19	1,829	+ 25	12	21,539	— 104	25	—
Bradford	,, 11	4,796	+1188	10	47,122	+ 7,967	46	—
Brighton	,, 19	985	+ 76	—	10,497	—	7½	—
Bristol	,, 17	5,146	+ 632	—	—	—	26	—
Devonport ..	,, 10	611	+146	23	11,402	+ 1,771	5	—
Dudley—Sto'rb'ge	,, 10	878	+134	23	18,646	+ 695	18½	—
Gateshead ..	,, 19	868	+ 54	23	20,191	+ 977	10½	+ ½
Gr'n'k—Pt. Glsgw	,, 10	738	— 34	23	11,893	+ 695	7½	—
Oldham—Ashton	,, 19	585	—105	23	12,208	— 776	8	—
Potteries	,, 10	1,663	+206	23	28,596	+ 2,993	28½	—
Southport	,, 10	339	— 99	23	6,719	+ 321	5½	—
South Staffs. ..	,, 10	780	— 70	23	17,945	— 878	21½	— ½
Swansea	,, 10	553	+ 49	23	11,648	+ 752	5½	—
Wolverhampton ..	,, 10	407	+ 76	23	8,533	— 278	10½	+8
Yorks. Wool Dist.	,, 18	658	+338	23	13,060	+ 5,604	6	—
Miscellaneous ..	,, 10	3,603	—	23	63,808	—	—	—
Burnley	,, 18	1,081	+382	—	—	—	10½	+3½
Burton-on-Trent ..	,, 19	354	—	11½	3,899	—	2½	—
Cardiff	,, 11	2,035	+111	10	21,067	+ 691	14	—
Chatham & District	,, 16	664	+ 155	24	13,229	+ 1,991	8·65	—
Cork	,, 16	480	—117	24	10,296	— 204	9	—
Dover	,, 18	229	+ 9	24	4,561	— 207	8	—

Locality.	Week ending	Receipts for the week.		No. wks.	Total to date.		Miles open.	
		£	£*		£	£*		*
Dublin	June 17	5,168	+ 567	25	112,704	+ 2,815	47	+ ½
East Ham	,, 18	774	+179	11	8,721	+ 1,011	5	+ ½
Glasgow	,, 18	14,550	+933	8	40,028	— 1,782	70	+5
Halifax (2 weeks) ..	,, 18	3,105	+573	11	16,297	+ 1,073	33	+2
Huddersfield ..	,, 18	1,312	+182	11	—	—	28	—
Hull	,, 18	2,167	+454	11	24,025	+ 2,671	18	+2½
Ilkeston	,, 15	149	— 9	11	1,691	—	3	—
Ipswich	,, 18	536	—	11	5,448	—	10½	—
Isle of Thanet ..	,, 18	785	+176	24	9,290	— 221	10½	—
Leeds	,, 18	5,798	+720	—	69,583	+ 4,400	81½	+2
Liverpool	,, 11	10,917	+7·8	24	287,380	+ 4,496	108	—
London C. C. ..	,, 18	12,488	+3892	11	130,202	+22,181	98½	—12
Manchester	,, 18	12,618	+1742	11	134,789	+ 3,617	131½	—
Newcastle	,, 18	3,800	+487	—	—	—	17	—
Portsmouth	,, 18	1,964	+420	—	21,646	+ 2,198	14½	—
Salford	,, 18	4,067	+584	—	48,578	+ 4,499	30	—
Sheffield	,, 19	4,795	+576	12	57,113	+ 2,014	33	+5½
Southampton ..	,, 16	966	—231	—	—	—	9	—
Southend-on-Sea ..	,, 15	345	+ 76	11	3,395	+ 218	6½	—
Sunderland	,, 19	1,814	+ 82	11	14,269	+ 357	20	+1
Tyneside	,, 15	968	+ 88	24	7,694	+ 929	8·9	+ ·4
West Ham	,, 16	1,108	—	16	10,968	—	8	—
Wolverhampton ..	,, 15	608	+215	—	—	—	7·560	—
Cen. London Rly. ..	,, 18	5,532	—142	25	171,719	— 2,807	6	—
City & S. Lon. Rly.	,, 19	2,531	—497	25	74,119	— 2,651	6½	—
Dublin—Lucan Rly.	,, 19	130	+ 9	25	2,723	+ 210	6½	—
G. N. and City Ry.	,, 18	990	— 13	18	16,659	—	3½	—
L'pool Ovarh'd Rly.	,, 10	1,075	— 45	26	30,499	— 18	5½	+4½
Mersey Railway ..	,, 18	1,526	+106	24	35,559	+ 7,126	4½	—

* Compared with the corresponding period of 1903.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE STEAM TURBINE AS APPLIED TO ELECTRICAL ENGINEERING.

By the Hon. CHARLES A. PARSONS, F.R.S.; G. GERALD STONEY; and C. P. MARTIN (Members).

(*Abstract of Paper read May 12th, 1904, in London.*)

(*Concluded from page* 1013.)

WITH regard to extracting the air, a great improvement has been effected by the use of a vacuum augmentor which has been recently introduced. In it the air pumps are placed about 3 ft. below the bottom of the condenser (see fig. 5). From any convenient part of the condenser, preferably near the bottom, a pipe is led to an auxiliary condenser, generally about $\frac{1}{10}$th the cooling surface of the main condenser, and in a contracted portion of this pipe a small steam jet is placed which acts in the same way as a steam exhauster, or the jet in the funnel of a locomotive, and sucks nearly all the residual air and vapour from the condenser and delivers it to the air-pumps. A water seal is provided, as shown on fig. 5, to prevent the air and vapour returning to the condenser. Thus if there is a vacuum of 27½ in. to 28 in. in the condenser, there may be only about 26 in. in the air-pump, which therefore need only be of small size, the jet compressing the air and vapour from the condenser to about half or a little less of its original volume. The small quantity of steam from this steam jet, which is only about 1½ per cent. of that used by the turbine at full load, together with the air extracted, is cooled down and condensed by the auxiliary condenser, which is generally supplied with water in parallel with the main condenser. In this connection it should be observed that condensation

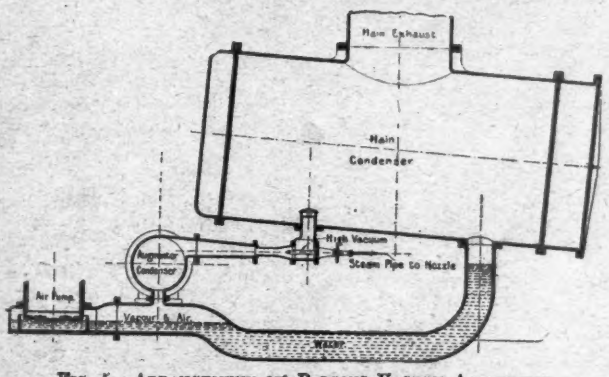


FIG. 5.—ARRANGEMENT OF PARSONS VACUUM AUGMENTOR.

in a condenser takes place much more rapidly and effectually if the air is thoroughly extracted than if there is much air present, as the air seems to form a blanket round the tubes and retards the steam getting to them. In Table I., on p. 1012, and fig. 3, are given two curves of a test on a 1,500-KW. plant for Sheffield, showing the difference of consumption with and without this augmentor; in these figures are included the steam used by the augmentor, which amounts to 450 lbs. per hour. The difference of vacuum is also shown, and when it is remembered that the augmentor jet only took about 1½ per cent. of the full-load steam consumption, it is easily seen from the gain of vacuum where the total gain by the use of the augmentor comes in. In this case the vacuum was not as good as it should be, as the cooling water was 85° F., and was only about 30 times the steam consumption at full load.

With reference to the original efficiency of a turbine being maintained, we may refer to the two sets of tests of the Newcastle Electric Supply Co.'s 1,500 KW. set after an interval of 16 months, as shown in p. 1012 and fig. 2, when it will be seen that absolutely identical results were obtained in the two tests. Careful examination of the blades of some of the original machines proves that, provided the velocity of the steam is not excessive, as it is not in the Parsons turbine, there is absolutely no cutting action on the blades.

In steam turbines the governing is effected either by a centrifugal governor of a well-known type, which keeps the speed constant, or by a core sucked into a solenoid to keep the voltage constant. In most cases, however, the centrifugal is preferable, especially where there are large changes of load, as in traction work, and it is also preferable where alternators have to run in parallel. The even turning moment makes the turbine specially suitable for the driving of alternators. It might be thought that there would be difficulty in making alternators driven by reciprocating engines parallel with turbines, and *vice versâ*, but in no case has the running not been satisfactory, and in some—for example, Elberfeld—the turbines have been found to steady the reciprocating engines.

It is important to note that, as in these steam turbines there are no rubbing surfaces, there is no need for internal lubrication, and therefore the exhaust is absolutely free from oil.

In the design of dynamos and alternators to be coupled to steam turbines, special regard is to be paid to the large centrifugal force to be encountered. Diameters have to be kept down, and excessive surface speed must also be avoided. Since, then, the diameter has to be small, the length must be increased in proportion, and a long core is the result, with moderate diameter, the contrary of slow-speed machines. At the same time, on account of the higher surface speed, the pitch of the poles is greater, thus giving more ampere-turns per pair of poles than is usual. In alternators this gives no trouble at all, as all that has to be provided is sufficiently strong field magnets to overcome the reaction of the armature, and sufficient magnetic resistance to allow of strong field magnets. This extra magnetic resistance can be given either in the air-gap or by saturation of the poles, as may be found desirable. These large poles also conduce to diminish magnetic leakage, and as a result very good regulation can be obtained. In low-voltage alternators rotating armatures are preferable, as the iron and copper losses are much less, especially where there are only two or four poles, but rotating armatures, although satisfactory for 500 to 2,000 volts, have not been found suitable for the higher voltages of 6,000 and 10,000 which are now common, and therefore rotating fields and fixed armatures have been adopted in many of the recent alternators. For continuous-current dynamos the same remarks apply, only here sparkless commutation has to be provided for. Carbon brush blocks cannot be used, as at these speeds the brushes are apt to vibrate, and so diminish the intimacy of contact and cause heating and undue wear. The result is that it has been found best to form the brushes of wire, gauze, or foil, preferably of brass, and these must be sufficiently flexible so as to maintain a good contact with the commutator over the whole section of the brush. It follows, therefore, that the properties of the carbon brush blocks in giving sparkless commutation without alteration of the lead of the brushes, cannot in turbine-driven dynamos be utilised, and other means must be adopted to secure sparkless commutation at varying loads. One way is to shift the brushes automatically according to the change of load, and this can be effected by connecting the brush gear to a steam cylinder controlled by a spring and supplied with steam from the point where the steam enters the turbine. Another method is to provide commutating poles, as proposed by Prof. Ryan and others, but the best method is to provide compensating winding, as proposed by Prof. Forbes, Deri, &c. By these means, with the improvements recently adopted, absolutely sparkless commutation can be secured with fixed brushes, up to, in plants for traction purposes, 100 per cent. overload.

The size of turbines is rapidly increasing, many of from 4,000 to 6,000-KW. capacity now being in course of construction, and it is anticipated that still larger plants will be made shortly. Up to the present there are about 600,000 H.P. of turbines of the Parsons type at work and on order in England and on the Continent, in various sizes ranging up to 7,000 KW.

It seems now certain that for many purposes, especially in large sizes, the steam turbine has become a most formidable competitor to the best reciprocating steam engines.

The discussion was opened by Mr. W. B. SAYERS, who inquired what was the critical velocity at which cutting of the blades occurred. He believed that carbon brushes could be used on turbo-generators, but they would have a short life, which, he thought, might be remedied by sub-division of the carbon blocks—a practice which he had adopted with success on certain high-speed generators. From his own experience, he felt compelled to criticise the authors' claim to having obtained sparkless commutation with 100 per cent overloads.

Mr. BARKER said there was no such thing as cutting of the turbine blades by steam in actual practice. He believed the smaller—say, 200-KW.—sizes were as economical in working as reciprocating engines, taking into account oil, maintenance, &c.

Mr. ROBERT HAMMOND'S experience with steam turbines had been very limited, but, from particulars of the works costs in his possession, the figures for oil in the principal turbine stations—Newcastle, Cambridge, and Scarborough—were much in excess of those at Leeds, viz., '03, and he also thought that the excess condensing water suggested by the authors as admissible with turbine condensing plant, might not be worth its extra cost. Condensing plant was very troublesome, and 27 in. of vacuum very hard to maintain. He commented on the falling off in efficiency at half loads, which, for the turbine, was 25 per cent., while at Leeds, with the Belliss engine, it was only 20 per cent., and, with the McLaren, 14·6 per cent. At full load the Belliss plant took 19·67 lbs. steam per KW.-hour, as compared with 18 lbs. for the turbine set; but the former included all steam used from the boiler, while the latter was measured from the condensing water.

Prof. DOLBY explained, from a theoretical standpoint, the great value of a good vacuum in obtaining the maximum amount of work from the steam turbine. He suggested that the "entering" blades might, with advantage, be discarded without greatly lessening the efficiency.

Mr. INSULL'S experience with Curtis turbines at the Chicago lighting station, was that they were more economical than similar reciprocating plants; this was largely contributed to by the smaller buildings and less first cost of the former plant.

Mr. H. DICKINSON thought it difficult to maintain a 27 in. vacuum, in ordinary practice, and said the principal advantage of the turbine was in its reduction of capital cost, as the steam consumption was not much better. The reduction of capital cost, however, was most important; in the case of Leeds the capital charges were equal to 1·1d. per unit, and works costs only ·89d. per unit.

Mr. FOX commented on the importance of the condensing question for turbines. Probably the cheapest way of maintaining a high vacuum was by means of a modified jet condenser, which would require less water, but (in the case of bad water being used) the hot feed would be lost. He believed condensers of

this type were being used on the Clyde Valley power scheme. As to the possibility of maintaining a high vacuum, he cited the case of a large works in the North of England, where a 6 ft. diameter exhaust pipe, 250 yds. long, was in use, and a 26½ in. vacuum was maintained. In regard to steam consumption, results were in favour of the reciprocating engine up to 1,000 H.P.; there was an equality at 1,500 H.P., and the turbine was the better at 3,000 H.P. He considered that the reciprocating engine gained more by high superheat than the turbine, and instanced the case of a small reciprocating engine in which the steam consumption was as low as 10 lbs. per H.P.-hour with 260° superheat and 190 lbs. boiler pressure.

Mr. C. H. MERZ advocated the turbine on the basis of its saving in total cost, which was the important point to consider. From tests undertaken on a 500-KW. Curtis turbo-generator at Cork, in which the steam pressure was 150 lbs., superheat 100° F., and vacuum 27 in., the steam consumption amounted to 20·5 lbs. per KW.-hour, and correcting for higher vacuum and superheat, they would get 19 lbs. per KW.-hour consumption. He considered that a high vacuum —say, 28 in.—presented no special difficulty under ordinary turbine conditions. He thought that the excellent results obtained with the surface condenser and Edwards air pump rendered unnecessary additional condensing devices in the majority of cases. In regard to brushes, he expressed his partiality for carbon, which was used on the Cork turbine set.

Prof. AYRTON commented on the advantages in quick starting which the turbine possessed. In the matter of steam consumption, he commented on the fact that at full load the Curtis and Parsons turbines were about equal, but at quarter-load the Curtis turbine is claimed to be far more economical than the Parsons, this being due to the nozzle construction and regulation employed in the Curtis type. This type of machine was also extremely frictionless.

Mr. L. GASTER stated that the turbine was about 30 per cent. cheaper than reciprocating engines of 1,000 to 3,000 KW., and it was also economical in both space and weight. In regard to oil consumption, he mentioned a case where some £1,000 per annum was saved in oil by the substitution of a 3,000-KW. turbine for reciprocating engines, in Germany.

Mr. W. CRAMP said that credit was due to the authors for the development of the high speed commutator. Few engineers realised the losses due to carbon brushes, and the loss in the extra windings would be more than compensated by the saving on the brush loss.

Mr. W. H. PATCHELL believed that some Continental authorities preferred wire-drawing the steam to cutting it off as in the Curtis turbine. In proposing high vacua, it must be remembered that the usual temperature of cooling water was 80° F., even if cooling towers were employed.

Mr. MORDEY mentioned that Italian experience of the turbine confirmed its superiority over the reciprocating engine.

The Hon. C. A. PARSONS stated that the yearly cost of oil at Cambridge amounted to ·003d. per unit, and in the case of a large Sulzer engine, the oil cost as much as 12½ per cent. of the coal. High vacua could be obtained in practice, and in Newcastle, a barometric condenser was maintaining a 28½ vacuum constantly.

Mr. GERALD STONEY, replying to the discussion, stated that no cutting of the blades occurred in the Parsons turbine. Carbon brushes were unsatisfactory with high-speed commutators, owing to the vibration and heating which occurred, and they used gauze brushes. Their compensating winding on the generators was a modification of Prof. Forbes's winding, brought out some years ago. Many compensating windings were too definite in their point of sparkless compensation. At full load they got a much larger range than with many other compensating windings. He did not think it possible to obtain such good results with the air pump as with the augmentor, as all air pumps were uneconomical at high vacua. At Cambridge they had maintained 29-in. vacuum for some years. There was no advantage in going higher than 200 lbs. steam pressures, owing to difficulties with pipes and valves, and the increased capital cost. In regard to areas, the Curtis and Parsons 5,000-KW. turbines occupied the same space. The Curtis tests given by Mr. Merz were the first obtained by an independent engineer, and agreed with the results previously published.

THE STEAM TURBINE IN MODERN ENGINEERING.*

By W. L. R. EMMET, Schenectady, N.Y.

THE Curtis steam turbine is the first radically new commercial machine different in type from either the Parsons or De Laval machines. The general purpose of the Curtis design is to produce results with a reasonable number of simple parts and at moderate speeds, while the Parsons turbine requires a very large number of small parts, and the De Laval turbine employs excessively high speeds inapplicable to mechanical purposes without the use of speed reducing gearing.

Mr. Curtis's experiments on steam turbines had been going on for about four years before the General Electric Co. undertook to build any machines for service. At the end of that period, and at a time now about four years ago, the author first became connected with the enterprise, being asked to express an opinion concerning the value of the invention.

* Abstract of a paper read before the American Society of Mechanical Engineers at Chicago.

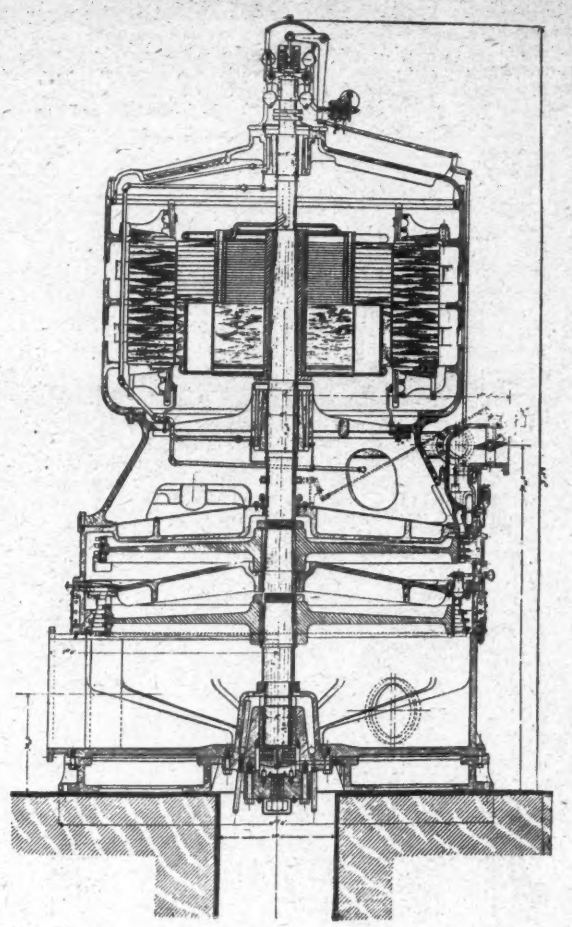


FIG. 1.

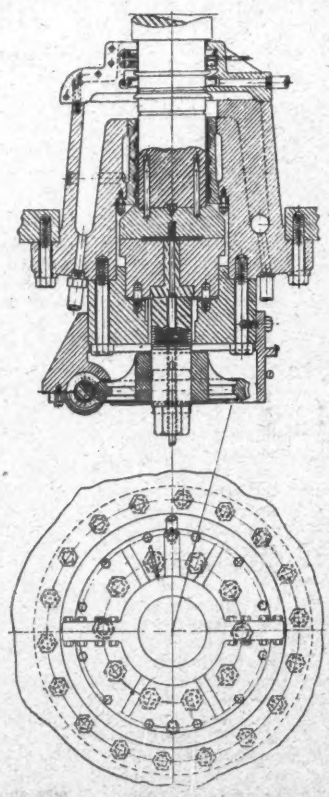


FIG. 2.

His report led to the beginning of work on a larger scale, the first step being to build a 600-KW. unit, which was put into operation at Schenectady in November, 1901. This machine was built on the general lines previously considered by Mr. Curtis, with a horizontal shaft and two stages, with groups of wheels in separate casings. Tests of the machine, which were carried on for some months, showed

very good results, which were published in the author's paper to the American Philosophical Society in April, 1902. The success of this machine led to the undertaking of commercial work on a large scale, and the experience so far obtained and a careful study of mechanical possibilities led to the adoption for this new work of radically new mechanical designs, applied to bucket and nozzle

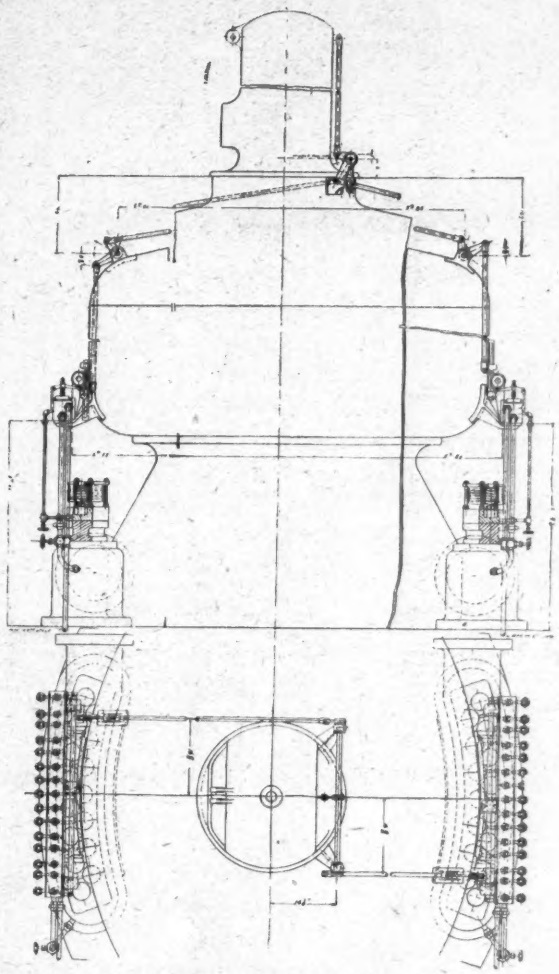


FIG. 3.—VALVE-GEAR.

arrangements similar to those previously used and first recommended by Mr. Curtis. The first machines designed of this new type were a 5,000-KW. unit for the Chicago Edison Co., and a 500-KW. unit, the latter of which was installed at Newport, R.I. Four machines from the former and about 40 from the latter design have up to the present time been installed.

These machines are built with shafts in a vertical position; the total weight of the revolving part being borne by a step-bearing at the foot of shaft, and the shaft being steadied and aligned by three bearings, one at the top of generator, another near the foot of shaft, and a third between the generator and turbine. Some of the important advantages of the vertical shaft type are as follows:—

The relative positions of revolving and stationary parts are definitely fixed by the step-bearing.

The stationary part is symmetrical, easily machined, and free from distortions by heat.

The shaft bearings are relieved from all strain, and friction is practically eliminated.

The shaft is free from deflection, and can be made of any size without reference to bearings, which can be placed where convenient, and operated with surface speeds which would not be practicable with the horisontal arrangement.

These features make possible the use of a very short shaft, and consequently the longitudinal spacing of moving and stationary parts is very little affected by temperature differences.

The turbine structure affords support and foundation for the generator.

The cost of foundations is very small, and the solidity and alignment of foundation is not of vital importance.

Much floor space is saved.

All parts of the machine are conveniently accessible.

Failure of lubrication cannot injure the shaft or other expensive parts.

Another new feature of these designs is the arrangement of valves; the turbine being governed by the successive opening of steam operated valves, which are independent of each other, but which are all controlled by the centrifugal governor. With this arrangement the speed control of the turbine is not dependent upon the successful operation of all the valves, since the governor automatically keeps open as many valves as the machine requires, and in the event of trouble with one valve opens another to take its place. The character of these first vertical shaft designs is illustrated by the cross-sectional drawing of the Chicago machine, fig. 1. Most of the drawings of parts which are here given show the designs which have been adopted in connection with later

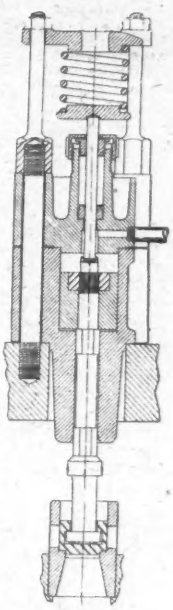


FIG. 4.

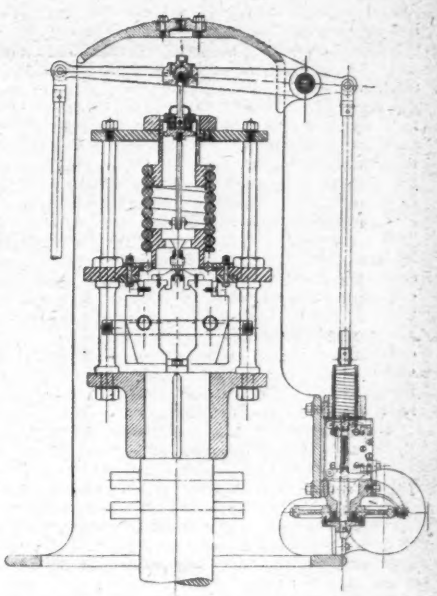


FIG. 5.—GOVERNOR.

machines, and do not apply to the machines at Chicago or others of that date. The principles involved are, however, the same in all.

In this Chicago machine there are two stages, each stage having a single wheel which carries four rows of moving buckets. On the stationary part there are three rows of stationary buckets opposite each group of nozzles used. The shaft is in one piece from the step-bearing to the top of the generator. The wheels are of cast-steel, mounted upon it with taper fits. The stages are separated by a cast-iron diaphragm fitted with valves, which are now operated by hand, but are being arranged to operate automatically, it being advantageous to constantly maintain a certain pressure relation between the stages.

The step-bearing is shown by fig. 2, and consists of two cast-iron blocks, one carried by the end of the shaft, and the other held

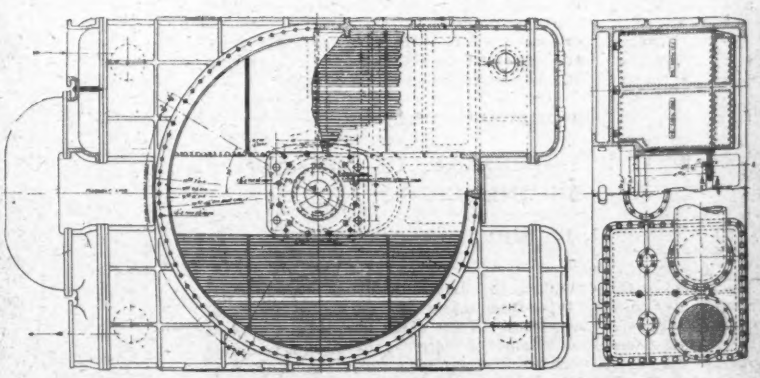


FIG. 6.—CONDENSER BASE.

firmly in a horizontal position, and so arranged that it can be adjusted up and down by a powerful screw. The lower block is recessed to about half its diameter, and into this recess oil is forced with sufficient pressure to balance the weight of the whole revolving element. About 5 gallons of oil per minute is used in the 5,000-KW. machine, but with a good alignment it could be satisfactorily operated with a much less amount. The oil, after passing between the blocks of step-bearing, wells upward and lubricates a step-

bearing supported by the same casting. This whole structure is inside the base, and a packing is used between the oil chamber and the base, so that oil or air cannot get into the vacuum chamber. A small steam pressure is maintained between the sections of this packing, in order that these objects may be accomplished with certainty. In many cases these same step-bearings have been operated with water instead of oil, in which case no packing is necessary, the water being allowed to pass into the base. In some of our latest designs water will be used exclusively, the lower surface of step-bearing being of wood, and no packing being provided.

The step-bearings have shown a ruggedness and stability far beyond our expectations. Many of our turbines have been operated under more or less temporary conditions in incompleted stations, and there have been many accidental stoppages of stop-bearing pressure while machines were running. In hardly any cases have such stoppages caused even an interruption of service. The step-bearing surface cuts immediately when lubrication is stopped, but the metal from it is removed very slowly and it has the power of re-establishing itself almost immediately when oil flow is again started. The step-bearing pressure has through accidents failed five or six times in the Chicago Edison plant, and all of the three machines now operating there are running on step-bearings which have been subjected to such stoppages. In no case has any harm resulted to the machines, and the bearings have always operated just as well as if they were in a perfectly new condition. In our newer designs we are providing a powerful brake bearing on the lower surface of a chilled iron ring carried by the lower wheel. This brake can be conveniently operated from the outside, and can be used to take the whole weight of the revolving part in case the step-bearing support should fail. In ordinary operation the shoes of this brake will be set about ·01 in. below the brake ring. It is thus in a position to receive the revolving part in case the step-bearing support should fail. Another and more important function of this brake is to stop the machine when it is desired to do so. One of the 5,000-KW. vertical shaft machines will run for four or five hours after the steam has been shut off, unless load is put upon it or a brake is applied.

The importance of good balance applies as well to vertical turbines as to those that are operated in a horizontal position. When the balance is good the bearings on a vertical turbine shaft are practically free from strain or friction.

Fig. 3 shows the connection of valve mechanism to governor in one of our new 5,000-KW. turbines. Fig. 4 shows one of the controlling valves used with this arrangement. Each of these controlling valves operates one or more main valves which communicate with the first stage nozzles. This controlling valve is so designed that it always passes positively from one of its seats to the other. No matter how gradually the force is applied, it opens both ways on the principle of a pop safety valve. It is thus always firmly seated and is free from the deterioration which leakage would cause. The total number of these valves required imposes a light load upon the governor, which is made strong enough to give any desired accuracy of speed regulation without the possibility of lag or sticking. The controlling valves on our earlier vertical shaft turbines were actuated by electric magnets. This mechanical arrangement (fig. 5) is simpler and more positive.

Fig. 6 shows a base for supporting one of our 5,000-KW. turbines, which also performs the functions of a surface condenser. This combination has been adopted in several of our newer designs; among them the 2,000-KW. unit, which is now installed at the St. Louis Fair. This arrangement is adapted to the production of the best possible vacuum with a given water supply, and also has the advantage of a considerable saving of space. Two 5,000-KW. units equipped with these condenser bases are now being installed for the Boston Edison Co.

The 500-KW. unit above mentioned is designed with two stages and three rows of buckets per stage. This machine has been tested under a variety of conditions at Newport. Among other tests that were made, the machine was operated on a rapidly changing railway load, the momentary variations of load amounting to about 120 KW. In one test the average load carried with this fluctuation was 250 KW., and the steam consumption was 24·4 lbs. per KW-hour output with saturated steam. Another test was run with similar fluctuations and with an average of 421 KW. The steam consumption under this condition was 20·7 lbs. of saturated steam per KW.-hour output. The best reciprocating engine under conditions of the first test would probably consume from 28 to 30 lbs. per KW.-hour.

The 5,000-KW. and 500 KW. two-stage machines above mentioned were, as I have said, designed in accordance with Mr. Curtis's original conceptions before we had the benefit of much study and practical experience. After construction of these machines had been begun, we became convinced that other arrangements of steam parts would be more advantageous, and began the design of a new type, the construction of which was well advanced before our first experiences with the first type were obtained. Machines of this type, which have very recently been put into operation, have started without any trouble or interruption, and given very perfect service.

We have recently obtained accurate tests from this first new machine as originally designed. The capacity of this machine is 2,000 KW. It operates a 6,600-volt 25-cycle generator at a speed of 750 revolutions per minute. It is temporarily installed in the General Electric Co.'s power station at Schenectady, with a surface condenser having 6,000 sq. ft. of cooling surface. The following are results obtained under different running conditions. The tests on March 12th and on May 11th were made upon different machines of similar design. Considering the different conditions, the results are consistent.

		March 12th.		May 11th.
Load in kilowatts ...	... 637	1,000	2,000	2,270
Revolutions per minute	... 750	750	750	750
Gauge pressure ...	... 150	160	155	100
Superheat F.	... 215	242	242	250
Corrected vacuum ...	... 28·2	28·9	28·73	28·1
Lbs. steam used per KW.-hour	20·1	16·3	15·3	16·2

Such analysis of results as we have been able to make indicates that a different proportioning of certain parts will give us a substantial improvement.

THE ST. LOUIS ELECTRICAL CONGRESS.

We are indebted to recent issues of our New York namesake for the following lists of papers which are to be brought before the great International Electrical Congress which is to be opened at St. Louis a few months hence:—

Section A. (Theory).—Chairman, Prof. E. L. Nichols; secretary, Prof. H. T. Barnes.

FOREIGN.—"Metallic Conduction," by Prof. Dr. Paul Drude.
"Electrical Standards," by Prof. Dr. W. Jaeger.
"Ions," by Sir Oliver Lodge.
"Magneto-Striction," by Prof. H. Nagaoko.
"The Theory of Ionisation by Collision," by Prof. J. S. Townsend.
"Secondary Standards of Lights," by M. J. Violle.
"Condensation Neuclei," by Mr. C. T. R. Wilson.
"Magneto-Optics," by Prof. P. Zeemann.
AMERICAN.—"The Mechanical Equivalent of Heat as Measured by Electrical Means," by Prof. H. T. Barnes.
"Atmospheric Neuclei," by Dr. Carl Barus.
"The State of Our Knowledge Regarding the Earth's Magnetism," by Dr. Louis A. Bauer.
"Magneto-Optics," by Prof. D. B. Brace.
"The Absolute Value of the Electromotive Force of the Clark and Weston Cells," by Prof. H. S. Carhart and G. W. Patterson, jun.
"The Electric Arc," by Prof. C. D. Child.
"Coherer Action," by Dr. K. E. Guthe.
"Electrical Discharges in Gases," by Prof. E. P. Lewis.
"Electrostriction," by Prof. L. T. More.
"The Unobtained Wave-Lengths between the Longest Thermal and the Shortest Electric Waves yet Measured," by Prof. E. Fox Nichols.
"Standards of Light," by Prof. E. L. Nichols.
"Magnetic Effect of Moving Charges," by Harold Pender.
"Electrical Theory," by Dr. M. I. Pupin.
"Alternating Current Measurements," by Dr. Edward B. Rosa.
"Radioactive Change," by Prof. E. Rutherford.
"Radioactivity of the Atmosphere," by Prof. J. C. McLennan.
"Electrical Discharge in Gases," by Prof. J. Trowbridge.
"Electrical Theory," by Prof. A. G. Webster.

Section B. (General Applications).—Chairman, Prof. C. P. Steinmetz; secretary, Prof. S. Sheldon.

"Direct-Current Commutation," by Prof. E. Arnold.
"Compensated Alternators," by Dr. O. S. Bragstad.
"Standarisation of Dynamo-Electric Machinery and Apparatus," by Col. R. E. Crompton.
"Calcul des Alternateurs," by M. Andre Blondel.
"Uber die Naturliche Radioactivität der Atmosphare und des Erdbodens," by Drs. Elster and Geitel.
"The Distribution of Voltage and Current in Closed Conducting Networks," by Herr C. Feldmann.
"Self-Regulating and Compounded Synchronous Machines," by M. A. Heyland.
Subject to be announced—W. M. Mordey.
"Rectifiers," by A. Nodon.
"Electricity in Ancient Egypt," by Sir W. Preece.
"Magnetic Leakage in Alternating-Current Machinery," by Prof. C. A. Adams.
"Electric Motors in Shop Service," by Mr. C. Day.
"Carrying Capacity of Cables and Conductors," by Mr. J. W. Esterline.
"Sparking Distances Corresponding to Different Voltages," by Mr. H. W. Fisher.
"The Design of Insulators," by Prof. H. J. Ryan.
"The Regulation of Alternators," by Mr. D. B. Rushmore.
"The Influence of Wave Shape upon Alternating-Current Meter Indications," by Prof. E. B. Rosa.
"The Equipment of a Commercial Testing Laboratory," by Dr. Clayton H. Sharp.
"Very High Voltage Transformers," by Prof. H. B. Smith.

Section C. (Electro-chemistry).—Chairman, Prof. H. S. Carhart; secretary, Mr. Carl Hering.

"Methods of Determining the Degree of Dissociation," by Prof. Dr. S. Arrhenius.
"Electro-metallurgy of Nickel," by Dr. W. Borchers.
"Electrolytic Methods for the Rapid Production of Copper Sheets and Tubes," by S. O. Cowper-Coles.
Subject to be announced—Dr. F. Dolezalek.
"Electrical Extraction of Nitrogen from the Air," by J. Sigfried Edstron.
"Alumino-Thermics," by Dr. H. Goldschmidt.
"Electrolytische Zerstörungen in der Erde," by Prof. Dr. F. Haber.
"Electro-metallurgy of Iron and Steel," by Dr. P. C. L. Heroult.
"Chlorine Smelting," by Mr. J. Swinburne.
"The Chemistry of Electro-plating," by Prof. W. D. Bancroft.
"The Lead Voltameter," by Mr. A. G. Betts and Dr. Edward Kern.
"The Preparation of Materials for Standard Cells," by Prof. H. S. Carhart and Dr. C. A. Hulett.
"Alkaline Batteries," by Thomas A. Edison.
"The Silver Voltameter," by Dr. K. E. Guthe.
"The Units Employed in Electro-chemistry," by Mr. Carl Hering.
"Notes on Electrolytic Copper Refining," by Mr. J. T. Morrow.
"The Energy Absorbed in Electrolysis," by Prof. J. W. Richards.
"The Relation of the Theory of Compressible Atoms of Electro-chemistry," by Prof. T. W. Richards.

British Aluminium Co.—On 14th inst. in the Chancery Court, Mr. Justice Buckley sanctioned the reduction of the capital of this company from £400,000 to £310,000 by the cancellation of 90,000 ordinary shares.

THE REPULSION MOTOR.

By F. W. CARTER, M.A. Cantab.

(*Continued from page* 949.)

Rotor Input and Output.—The output of the armature, measured at the conductors, is, from equation (5),

$$\frac{8\,n^2\,B^2}{\pi^2\,L\,p}\cdot\frac{(p\cos a - q\,\omega\sin a)\,\omega\sin a}{1+q^2}. \qquad (14)$$

The copper loss in the armature is, from equation (1),

$$\frac{8\,n^2\,B^2}{\pi^2\,L\,p}\cdot q\,\frac{p^2\cos^2 a + \omega^2\sin^2 a}{1+q^2}. \qquad (15)$$

Hence the input to the armature conductors is

$$\frac{8\,n^2\,B^2}{\pi^2\,L\,p}\cdot\frac{p\,q\cos a + \omega\sin a}{1+q^2}\cdot p\cos a. \qquad (16)$$

Efficiency of Rotor.—From equations (14) and (16) the efficiency of the rotor is—

$$\frac{p\cos a - q\,\omega\sin a}{p\,q\cos a + \omega\sin a}\cdot\frac{\omega}{p}\tan a. \qquad (17)$$

This reaches a maximum at speed ω, where

$$\frac{\omega}{p}\tan a = \sqrt{1+q^2} - q,$$

and the efficiency is then—

$$(\sqrt{1+q^2} - q)^2. \qquad (18)$$

It will be seen from this, that q must be made small in order to secure good efficiency, especially since the above maximum occurs at a speed far above any that would practically be reached.

Current Input.—The current in the stator coils is in the phase (pt) of the applied magnetic field. Assuming the current per pole, therefore, to be $I\sin pt$, the power input to the iron is—per pole—from equation (6)—

$$\tfrac{1}{2}\,I\,\frac{4\,m\,p\,B}{\pi\,x}\cdot L\,x\,x^1\cos a\,\frac{R\,p\cos a + L\,\omega\,p\,s\,m\,a}{L^2\,p^2 + R^2}.$$

If there are $2w$ poles in all, the total input to the iron is—

$$w\,I\,\frac{4\,m\,B}{\pi}\cdot x^1\cos a\,\frac{q\,p\cos a + \omega\sin a}{1+q^2}. \qquad (19)$$

The output of the iron is given by equation (16), and the difference between these quantities is the iron loss. Since, however, the latter would be difficult or impossible to calculate, and that we are here making a general investigation of the properties of the repulsion motor rather than a finished calculation of a special machine, we shall, in order to find the manner in which the current varies, neglect the component due to the iron loss and determine the current by equating the expressions given in equations (16) and (19) thus—

$$w\,I\,\frac{4\,m\,B}{\pi}\,x^1\cos a\,\frac{q\,p\cos a + \omega\sin a}{1+q^2} = \frac{8\,n^2\,B^2}{\pi^2\,L\,p}\cdot\frac{p\,q\cos a + \omega\sin a}{1+q^2}\,p\cos a,$$

$$\therefore I = \frac{2\,n^2\,B}{w\,\pi\,m\,L\,x^1},$$

which, from equation (10),

$$= \frac{1}{2\,w}\cdot\frac{n^2}{m^2}\cdot\frac{x}{x^1}\cdot\frac{E}{L\,p}\times \frac{(1+q^2)^{\frac{1}{2}}}{\left[(1 - x\,x^1\cos^2 a)^2 + \left(q + \frac{\omega}{p}\,x\,x^1\sin a\cos a\right)^2\right]^{\frac{1}{2}}}. \qquad (20)$$

Torque per Unit Current.—From equations (11) and (20), we obtain the torque per unit current—

$$\frac{w\,x\,x^1\,E}{p^2}\times \frac{(p\cos a - q\,\omega\sin a).\sin a}{(1+q^2)^{\frac{1}{2}}\left[(1-x\,x^1\cos^2 a)^2 + \left(q + \frac{\omega}{p}\,x\,x^1\sin a\cos a\right)^2\right]^{\frac{1}{2}}}. \qquad (21)$$

Hence the starting torque per unit current is a maximum for the position of the brushes (value of a), which makes—

$$\frac{(1 - x\,x^1\cos^2 a)^2 + q^2}{\sin^2 a\cos^2 a}$$

a minimum, *i.e.*, which makes—

$$\frac{(1 - x\,x^1)^2 + q^2}{\tan^2 a} + (1+q^2)\tan^2 a, \text{ a minimum.}$$

This requires—

$$\tan^4 a = \frac{(1 - x\,x')^2 + q^2}{1+q^2}. \qquad (22)$$

This will be found to give a larger angle than is given by equation (13), and will probably be near to the best average position for the brushes.

Resultant Field.—The resultant field at θ is—

$$B\cos\theta\sin pt - B^1\cos\overline{\theta - a}\sin\overline{pt + \beta}$$
$$= \tfrac{1}{2}\,(B^2 + B^{1^2} - 2\,B\,B^1\cos\overline{\beta - a})^{\frac{1}{2}}\sin\overline{pt + \theta - \gamma}$$
$$+ \tfrac{1}{2}\,(B^2 + B^{1^2} - 2\,B\,B^1\cos\overline{\beta + a})^{\frac{1}{2}}\sin\overline{pt - \theta - \delta}.$$

From this we see that the resultant field is composed of two revolving fields, one of which has amplitude—

$$\tfrac{1}{2}\,(B^2 + B^{1^2} - 2\,B\,B^1\cos\overline{\beta + a})^{\frac{1}{2}} \qquad (23)$$
$$= \tfrac{1}{2}\,B\left\{\frac{\left(1 + \frac{\omega}{p}\right)^2\sin^2 a + q^2 + 2\,q\left(1 + \frac{\omega}{p}\right)\sin a\cos a}{1+q^2}\right\}^{\frac{1}{2}}$$

and revolves uniformly at synchronous speed in the same direction as the armature, whilst the other has amplitude.

$$= \tfrac{1}{2}\,(B^2 + B^{1^2} - 2\,B\,B^1\cos\overline{\beta - a})^{\frac{1}{2}} \qquad (24)$$
$$= \tfrac{1}{2}\,B\left\{\frac{\left(1 - \frac{\omega}{p}\right)^2\sin^2 a + q^2 - 2\,q\left(1 - \frac{\omega}{p}\right)\sin a\cos a}{1+q^2}\right\}^{\frac{1}{2}}$$

and revolves at the same rate in the opposite direction to the armature. Where $\theta = (\gamma - \delta)/2$, the amplitude of the resultant field is the sum of the amplitudes given by 23 and 24, whilst at right angles to this it is their difference.

We are now in possession of plenty of information, and it only remains to translate it into the language of the electrician. We will first form an estimate of the order of magnitude of the quantities involved, since, without this knowledge, our interpretation is liable to be vague.

The quantity $x\,x^1$, depending on the leakage, should of course be made as near unity as possible. With a well designed machine, I should judge that the value will be of the order ·96, and is not likely to be less than ·95. In coming to this conclusion, I am guided by the fact that the corresponding quantity for a polyphase induction motor of the same ideal type leads to $x\,x^1/(2 - x\,x^1)$ as the maximum possible power factor. With $x\,x^1 = ·96$, this formula makes this maximum power factor 92·3 per cent.; this is not unreasonable, especially as we are assuming a sine E.M.F. wave, and taking no account of hysteretic or other distortion of the current wave.

The angle a, by which the brushes are shifted from the pole centre, will be of the order of 6° if the maximum possible starting torque is required, and, perhaps, double this amount if the position of greatest torque per unit current is preferred for the brushes. These conclusions follow from equations (13) and (22).

The quantity q—the ratio of resistance to inductance in the armature circuit—must, as stated immediately after equation (18), be made very small. If $q = ·01$, the maximum possible efficiency of the armature winding is about 98 per cent., and even this is at a speed far above the highest that would be reached in practice ($\omega = p\cot a$, approx.). At synchronous speed, with $a = 10°$, the efficiency is—from equation (17)—about 94·6 per cent., so that even at this speed 5 per cent. of the input would be wasted in heating the armature winding, whilst at lower speeds the waste would be greater still, absolutely as well as relatively.

We will assume, therefore, that $q = ·005$, and leave it until later to determine the factors affecting q. We will further assume that $x\,x^1 = ·96$, and that normally $a = 11\frac{1}{2}°$, so that the brushes are set nearly in the position giving maximum starting torque per unit current.

We shall accomplish a considerable portion of our interpretation by plotting curves from the equations we have deduced, showing the mode of variation of the several quantities involved. Figs. 3, 4 and 5 give such curves, and

in these the ordinate, where it is not a mere ratio, is quite arbitrary, and, being stripped of unessentials, is intended to show only the variation of the function plotted, thus representing a characteristic of the repulsion motor in general

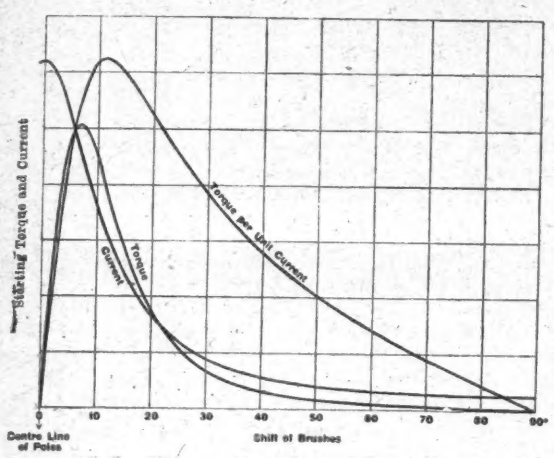


FIG. 3.

rather than the corresponding feature of a particular motor. These curves are plotted for a practically constant applied voltage.

Fig. 3 gives starting torque and current for different positions of the brushes. It will be seen that the starting torque reaches a maximum when the brushes are between 6° and 7° (electrical) from the centre of the pole. When

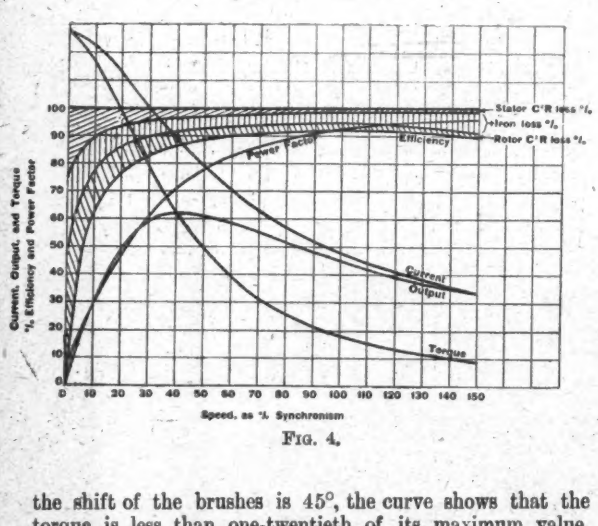


FIG. 4.

the shift of the brushes is 45°, the curve shows that the torque is less than one-twentieth of its maximum value. The torque per unit current reaches its maximum value when the shift of the brushes is somewhat greater that 11°. Equation (11) shows that the torque at any particular speed varies as the square of the applied voltage. Fig. 4 shows how the torque decreases as the speed increases, and may be compared with fig. 6, in which is shown a speed-torque curve for a continuous current series motor, plotted to speed as abscissa.

The power factor is very low at starting, and continually improves as the speed rises. It would not in practice, however, be as low as is shown by the curve—which is deduced from equation (9)—as the neglected component of current in phase with the E.M.F. is considerable at starting. The iron loss, which has also been neglected in obtaining equation (9), increases the power component of the current still further; in fact, the power factor at starting would probably be several times greater than is shown in fig. 4. The initial power factor could be improved up to a certain point by increasing q, that is, by inserting a starting resistance between the rotor brushes—but this diminishes the torque faster than the current, so that the torque per unit current is diminished with increase of q. In fact, this procedure has the effect of increasing the power component of the current rather than diminishing the wattless component, and wastes the extra power in heating the starting resistance.

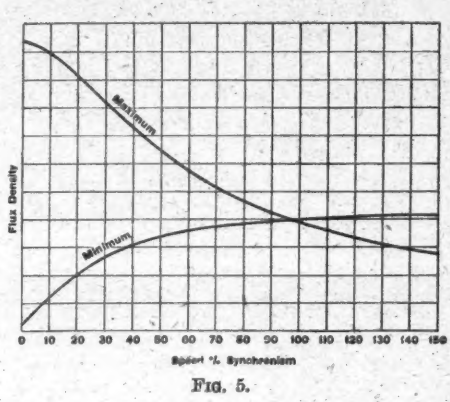


FIG. 5.

The current curve in fig. 4 is obtained from equation (20), and also assumes that the iron and stator losses are negligible. It will, however, suffice to show the general character of the variation in current with speed, although it is not to be expected that it will be exactly deducible from the output, efficiency, and power factor, since the efficiency includes the

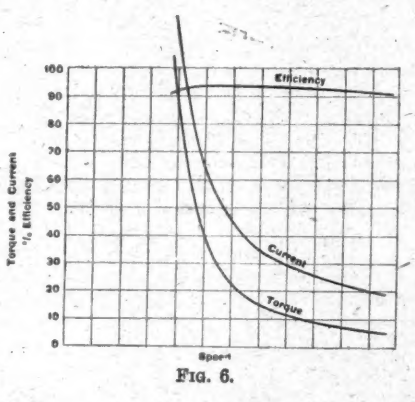


FIG. 6.

above-mentioned losses. Equation (20) shows that the current, at any particular speed, varies as the applied voltage. If by means of a compensator the terminal voltage be varied at starting in such manner as to give a constant torque until a certain speed is reached, it will be found that the motor current remains practically constant also, until this speed is reached.

(To be concluded.)

REVIEW.

Electric Traction. By J. H. RIDER, Chief Electrical Engineer, London County Council Tramways. London: Whittaker & Co. 1903. Price 10s. 6d. net.

If not quite as numerous as dead-leaves in Vallombrosa, we have at any rate had so many efforts put forward by one and another in the direction of electric traction hand-books, that any new instance might expect to receive pretty severe criticism; the more so as the books hitherto published have, in our opinion, almost entirely failed to reach the proper standard of up-to-date and terse compactness combined with correct technicalities.

Some have been mere paste-and-scissors productions; others have erred by trying to include too much, and, instead of a "hand-book" upon the subject, the result has been more of an "Encyclopædia Tramwayannica."

This is naturally due, in some respects, to the daily developments taking place in electric traction, which make it practically impossible for any author to write his pages so as to be absolutely up to date, even after the short interval

between finishing the MSS. and issuing the volume to the public.

Mr. Rider is, however, to be congratulated on having come as near to the desired standard as mortals may achieve; and his book is, to begin with, decidedly the best that we have as yet seen in regard to comparative size and value of contents; his aim, indeed, appears to have been the contriving that these should, as far as possible, be in inverse proportion—a very difficult task to carry out, as every critic and many an author know full well.

Intended, as it is, for "specialists," this book does not begin with chapters of ancient history dealing with the very early days of electric traction or motor work, but plunges straight into the subject, and embraces from a strictly practical standpoint a series of concise, yet complete, short essays upon each main feature, or group of features, of an electric tramway.

An introductory chapter of 23 pages only suffices the author for a brief exposition of the general principles involved in the employment of a rotary motor, its efficiency, necessary output and input under varying conditions, &c.; and, thereafter, with this laudable commencement, Mr. Rider gives separate chapters upon generating plant, switchgear, distribution, motors, controllers and rolling stock generally, permanent way, overhead work, conduit and surface contact systems, accumulators, combined lighting and traction power stations, and a short (too short to be of real value) chapter of electric railways.

Perhaps, when the L.C.C. have taken over the various London tube lines, and are also operating light railways into and through the suburbs, Mr. Rider may be tempted to expand that last chapter into a separate book! Meantime he shows wisdom in dealing most fully with electric tramways as the "established" form of electric traction, leaving the history of electric railways to be chronicled after it has been made, and their theory to be explained when thoroughly worked out. This will not be just yet, we fear.

As might be expected from an engineer of Mr. Rider's experience, the technical information throughout this book, in regard to the electrical side of his work, is practically all one could ask for; the glaring slips (to which the most learned are sometimes liable) are not only absent, but we have not even found the few minor mistakes seldom missing from technical books.

When, however, one begins to study the book as a tramway man rather than as an electrical engineer, there arise at once quite a number of very debateable assertions laid down as law by Mr. Rider, and in regard to which we should say that the more he sees of tramway work the broader his views will become. At present he offers, apparently without fear of contradiction, opinions that we venture to think he will himself consider to be hasty and prejudiced in less than five years' time.

It would certainly have been better to delete the last few paragraphs of his introductory chapter, to which he gives the side title of "Company *v.* Local Authority."

There should be no "versus" in the case at all; and there never would have been if the local authorities themselves had not forced battle on the companies. It is more than time that some sound sense was knocked into heads on both sides, and this ridiculous idea of *necessary opposition* between the two put an end to for ever.

Mr. Rider states that the laying of a tramway line under Parliamentary powers practically creates a monopoly of the streets. His experience of London 'bus drivers, and other people's experiences of magistrates before whom obdurate carters and van drivers are sometimes summoned, will hardly bear out this idea of a monopoly.

Moreover, he states that this monopoly (which, in practice, we say, seldom exists) ought not to be given for private profit. We agree: nor ought it to be assumed at the public risk. A reasonable combination which should avoid excess of both is what any sensible man would suggest as the proper course to follow.

Mr. Rider considers that the capital of a company being borrowed in perpetuity is subject to no sinking fund charges, and, therefore, any working profit is available for paying dividends! True, there is, perhaps, no law making it a criminal offence for directors and shareholders not to put money by each year for a sinking fund; but, in these days of stringent company law and difficult finance, there would be very little support given to any company which did not anticipate its *coup de* DISgrace of purchase at scrap iron price to be received sooner or later under the General Tramway Act, by setting aside each year a substantial sum for redeeming the capital properly sunk in the undertaking, but not to be repaid by the purchaser.

Mr. Rider must have forgotten for the time being the 43rd section of the 1870 Act. Would that we could all consign it to the everlasting limbo it deserves.

Doubtless, however, the author will, as suggested above, delete the whole of this very controversial matter from the next edition of his book; the topic is not an essence of his main subject, and unless fully and fairly treated, is best not touched at all.

Two small points in his introductory chapter require notice; he refers to the possible use of trailer cars at busy times to avoid increasing the frequency of services. Surely Mr. Rider here forgets his Board of Trade! There is precious little saving about trailer cars when each one must be provided with a brakesman and conductor, which means double staffing without the convenience of extra power on the cars, as would be given if additional motor cars were put on.

We agree with Mr. Rider in objecting to the "car-mile" as a unit of comparison between different lines or systems; but his "passenger-mile" suggestion is equally at fault. Some lines do not really know how many individual passengers they carry. If this could be told with certainty, then a better basis of comparison would be the "passenger-ton-mile," but even this ignores altogether such important matters as difference in grades and climate. If there is any real necessity for creating a friendly rivalry between different tramway systems, then let the comparison be as from the watts per ton-mile to the average fare per passenger; but we don't think that much good is to be gained thereby.

Mr. Rider is quite in his element when dealing with the electric generating and distributing plant; and, in the chapters that describe these parts of an electric tramway, he gives in a very clear and concise manner the best and latest practice. This also applies to the chapters upon motors and controllers, both of which are most excellent.

Coming next to "rolling stock," Mr. Rider lays himself a little more open to brief criticism. He seems—as regards type—to lean towards the single-deck car, of "combination" design if possible, so as to give both inside and outside seating accommodation. Such a car must, however, be extremely heavy to carry the same number of passengers as a four-wheel double-decker; and the facilities for overcrowding (which is a thing that every manager needs to watch) are not nearly so great.

In some instances, workmen's cars of the double-deck double-truck type—built to seat, say, 75—are obliged to carry more than twice as many; and this traffic could not be carried on by single-deckers.

"If a roof," says Mr. Rider, "could only be put over the outside seats (of a top-deck car) in wet weather, they would be largely patronised." Here is an instance showing how difficult it is to be up to date in a book on electric traction.

Mr. Rider cannot have written the above sentence more than a year or so ago at the most, one would say; and yet in almost all the large towns we now see the double-deck cars—or a proportion of them—being covered in as a protection against the weather, with very great pecuniary advantage. Indeed, the additional receipts from such cars in some places are estimated at £1 per car per day, as compared with the open upper decks.

Then again, when dealing with car trucks, Mr. Rider has nothing to offer other than the rigid four-wheel truck of very limited wheel base, and the bogie at each end of the car, which greatly increases the dead weight.

Now that radial axle trucks, giving to four-wheel cars a wheel base of 8 ft. or more, are on the market, there will be a new type here for Mr. Rider to treat in his next edition.

He expresses a cautious preference for steel-tired wheels as compared with those of chilled iron. On this point, as will have been gathered from our recent article on "Chilled-iron

v. Steel-tired Wheels," there are wide variations of opinion. It is true that steel tires do not flat so easily; and if they do, the flat can be turned off without any trouble. The principal objection to chilled iron is, no doubt, the occasional breaking of flanges, and this, of course, involves the rejection of the whole wheel, although the tread may be comparatively unworn. On the other hand, the diminution of diameter of a steel tire during its life is a serious drawback.

Mr. Rider omits any reference to the "thermit" process of rail-joint welding, although he mentions electric and cast-iron welds. To our mind, the former has distinct advantages over the last two, and its increased use ought to be evidenced.

He also ignores the mechanical ear, which dispenses with soldering, but requires a slightly larger size of ear, so that the trolley wheel suffers more wear and tear. An experience of the author in America, however, respecting a so-called double-trolley system, may be worth quoting as a recompense for any such small omission; he saw, he says, an instance where the local authority required that no earth or rail return should be used, and accordingly a second trolley wire was erected for each line; but the engineer of the line informed him that this second wire was merely a blind, that they only had current in one, and that the rails were still used!

Where else could this happen, but in the country of magnificent audacity?

Mr. Rider has naturally very much to say in regard to the conduit, though, if all tales are true, it is not quite such plain sailing in any respect, with regard even to the elaborate and expensive L.C.C. system, as Mr. Rider would have us believe. He admits the great first cost, and says that track-work and paving only costs from £26,000 to £32,000 per route mile (double track), which would be prohibitive unless a very frequent service could be maintained.

We should say that the expenditure of such a sum would, even in the latter case, be a wicked waste of money when an excellent overhead trolley wire system can be given for a third or a half of the amount.

A still more biting comment upon the ways and methods of those authorities who have assumed to themselves the supreme knowledge of what tramway systems ought to be, is given in Mr. Rider's chapter upon surface contact systems. In the text we read, with regard to the Lorain system, "the line has been working fairly satisfactorily for some time in Wolverhampton, but there has not been sufficient experience for a correct opinion to be formed as to its ultimate value."

In a footnote to the above, Mr. Rider says:—"Since the above was written, the Wolverhampton Corporation has decided to remove the Lorain apparatus, and to equip the lines on the overhead system."

Mr. Rider, however, reckoned without allowance for versatility of genius, or influence, or something of that sort, and hence finds himself obliged to stick on to the page in question the following *erratum*:—"While these pages were in the press, the Wolverhampton Corporation reversed its former decision, and the Lorain system is now to be used throughout that town."

One can imagine the printers of Mr. Rider's book ringing up that gentleman every now and then to ask whether there was any further change of opinion of the Wolverhampton Corporation, or whether the last would hold good till the presses ran off the first edition!

On accumulators, Mr. Rider takes up quite the usual position—their proper place is not on or about the cars, but either at the power house or in sub-stations.

At the same time we are not quite sure that the saving due to storage more than makes up for the losses of extra transformation of energy. The balance is pretty even, and very little makes it go over either way.

Taken as a whole, this book is, we think, easily first of its kind; it is not too abstruse or advanced for the young student, nor yet will the experienced engineer find it full of a good deal that he has already had to forget.

On the contrary, it should be of value to him as a veritable handbook and work of reference, which can be taken anywhere without trouble.

The illustrations, tables, diagrams, &c., are extremely numerous, explicit, and most of them *new*, which is a great deal to say in these days of extensive borrowing from catalogues and price lists.

We congratulate the author, publishers, and printers on having turned out a very useful and good-looking volume.

THE ELECTRO-THERMIC PRODUCTION OF IRON AND STEEL.

In a paper bearing the above title, read before the Canadian Society of Civil Engineers, Dr. A. Stansfield, A.R.S.M., discusses the technical and commercial possibilities of the various processes which have been suggested for the preparation or refining of iron or steel in the electric furnace. Relying on a large number of figures, the author holds that electrical energy can be bought in Canada on the large scale at a price of about 0.15 cent per E H.P.-hour, or 0.20 cent. per KW.-hour. If, then, the reduction of 1 metric ton of pig-iron from ore requires 2,500 KW.-hours, the cost of the energy comes to $5.00. Against this may be set the price of the fuel saved by using electrical heat. This is about 0·6 ton of coke, which, at $2.50 per ton (the average price at ovens in the United States during 1902) is equal to $1.50 per ton of iron. Thus, electrical smelting of such ores as are capable of treatment in the blast furnace cannot compete with the latter, even where very cheap water-power is available, unless the price of coke is $8.00 per ton. Arguing on a similar basis, Keller stated, before the Iron and Steel Institute, that iron ores might be smelted electrically in a remunerative fashion in such countries as Brazil, Chile, and New Zealand. But, before this proposition is accepted, it is necessary to ascertain at what prices pig could be imported into those lands. There are, however, certain ores, such as iron sands and titaniferous ores, which can only be treated with difficulty in the blast furnace, although perhaps the blast furnaceman's objections to the latter class of ore are greater than they should be; in dealing with these, the absence of the blast and the higher attainable temperature may render the electric furnace more useful. Moreover, refractory ores exist which can only be treated at all if they prove suitable for reduction in the electric furnace. There is also a greater probability that electrical treatment may be commercially possible in the production of charcoal iron, because of the greater value of the product, and the higher cost of the fuel.

As regards the direct production of steel from the ore, the fact that the electrical furnace works with no more fuel than is needed to reduce the iron oxide renders it possible to have an excess of oxide present; and, perhaps, this excess might be used to carry off into the slag the bulk of the phosphorus and sulphur. According to Goldschmidt's statement respecting the Stassano furnace, steel can be produced therein directly from the ore at a price which would compare with that of open-hearth or Bessemer steel; while according to estimates relating to a 1,000-H.P. Kjellin furnace, molten steel can be made from cold pig and scrap at the rate of 1 metric ton per 800 E.H.P.-hours, *i.e.*, at about one-fourth the cost for energy of that incurred in the reduction of ore to pig. Probably the greatest field of usefulness of the electric furnace in the metallurgy of iron and steel will be found in the production of crucible steel. It still pays to fuse this metal in small vessels in order to protect it from the gases present in an open-hearth furnace; and since the electric furnace can smelt it more cheaply, and protect it equally well from any objectionable gases, the crucible ought to give way before the electric furnace. Electrical heating, too, should replace the open-hearth furnace in the manufacture of the more expensive varieties of steel, where the cost of fusion is less important than the soundness of the metal.

Dr. Stansfield then proceeds to figure and describe the numerous types of electric furnace which have been constructed or proposed, including the Stassano, the Héroult, the Siemens, the Keller, the Harmet, the Kjellin, and the Gin apparatus. The Stassano and Héroult furnaces work intermittently, and should, therefore, be more suited to the manufacture of steel; the Keller and similar furnaces run continuously, and should, therefore, be better adapted for the reduction of ores. In the production of steel an oxidising slag is employed to remove the impurities from the pig;

this slag is liable to react with the carbon electrodes, corroding them, and being reduced to a condition in which it cannot deoxidise the metal. To avoid this difficulty, the electrodes in the Héroult furnace are kept above the surface of the slag, the current passing into the charge by means of an arc. In the Gin furnace metallic electrodes cooled with water are employed; while in the Kjellin furnace there are no electrodes.

The author holds that the electrical manufacture of crucible steel is technically and financially possible in Canada, and that furnaces might be laid down for the preparation of the tool steel which is now so largely imported; the energy might be developed by means of water power, or by gas engines fed with blast furnace gas. The problem of treating the titaniferous iron sands should also be gone into, partly because Rossi has already shown that the difficulties in dealing with them have been over-estimated, and also because the more powerful reducing capacity of the electric furnace allows a ferro-titanium to be won from these ores instead of leaving a slag containing all the titanium in the form of unreduced oxide, as happens in the ordinary blast furnace.

ELECTRIC RAILWAYS IN GERMANY.

Proposed High-Speed Duration Trials with Single-Phase Current.

The Studien Gesellschaft fur Elektrische Schnellbahnen, of Berlin, has now issued the long-expected report relating to the experiments with electric locomotives on the military railway between Marienfeld and Zossen in the vicinity of the German capital. It appears from the report, which only deals with the later trials which took place between September and November of last year, and during which speeds of as high as 131 miles an hour were attained, that not a single accident occurred in the whole of that period. The tests have shown, according to the report, that with a good track and high-pressure alternating currents and equivalent rolling stock, it is possible to travel at a speed which had previously not been reached, and that, too, without endangering public safety. It has now been decided by the directors of the Studien Gesellschaft to continue the experiments, and the hope is expressed that the State railway authorities will also support the company in this direction by again placing the military railway at its disposal. The object in view is to make a series of duration trials in order to obtain further experience, and at the same time to test the application of the single-phase alternating current for high-speed electric railway working. Although the military railway is scarcely suitable for duration trials, it has been selected, at all events provisionally, for the purpose in question. It will be necessary to erect special plant at the Oberspree central station so as to enable the further tests to be carried out.

An appendix to the report of the Study Co. for express electric railways definitely shows that the two schemes, which were some time ago briefly stated to have been prepared for the establishment of a high speed electric railway between Berlin and Hamburg, are due to the Siemens & Halske Co. and the Allgemeine Electricitäts Gesellschaft respectively. In the case of the project elaborated by the Siemens & Halske Co., the construction is proposed of a single line with the trains utilising, in the towns, the tracks of the existing railways by way of a beginning. The expenditure is estimated at £3,500,000, whereas that for a complete double track line is computed at £5,250,000. It is suggested that the trains, which would be formed of from three to five cars, should follow each other at intervals of two hours, with a stop at Wittenberg, and the journey between the two cities accomplished in 1 hour and 55 minutes. The scheme of the Allgemeine Co. proposes the establishment of a double track railway, with trains composed of three or five cars running at the rate of 100 miles an hour at the outset, and covering the distance in 1 hour and 47 minutes, while the journey would only occupy 1 hour 25 minutes with a subsequent increase which is contemplated in the speed to 124 miles an hour. The expenditure on the railway for a 100 miles an hour line is calculated at £6,250,000, and at £7,000,000 for the higher speed. It does not, however, appear that any immediate prospect exists of either of the plans developing into a practical scheme likely to be proceeded with in the near future.

A scheme has been submitted to the Prussian and Saxon Governments which proposes the construction of a long-distance electric railway between Halle and Leipzig. A similar project from another source was brought forward a few years ago, but it did not reach an advanced stage. On the present occasion the proposal, which emanates from the Berlin Allgemeine Co., is soon to assume definite shape. The railway is to proceed from Halle *viâ* the districts of Bruckdorf, Bennewitz, Grobers, Grosskugel, Schkeuditz, Alt-Scherbitz, Moddwitz, Quasnitz, and Wahren to Leipzig. It is intended to utilise the existing streets in these localities for the purpose of the railway, but a special permanent way will be built outside them in order that the trains may attain a high speed of from 37 miles to 50 miles an hour.

Among various proposals in Berlin may be mentioned the reported intention of the State Railway Administration to transform the metropolitan railway to electric traction. This rumour is, however, premature, and is doubtless due to the experimental results obtained on the suburban line between Nieder-Schoneweide, Johannisthal, and Spindlersfeld with the single-phase alternating current system. These trials are to be continued, in so far that the motor carriages under test are to be brought experimentally into use in the course of the next few months for the regular haulage of passenger trains. In the meantime it may be noted that the extension is now assured of the elevated and underground electric railway through the Bismarck Strasse to the Grunewald, or people's park. The work is to be finished in 1906. With regard to the projected electric railway on the Langen suspended system, which is proposed by the Continental Company for Electrical Enterprises, it appears that the company is at present engaged on the preparation of special plans for the route between Gesundbrunnen and Rixdorf. The negotiations on the subject of the construction of the railway—or, rather, of an experimental section of it, so as to allow the system to be judged from an æsthetic point of view—have not yet been concluded with the municipal and Government authorities. On the other hand, the Highways Committee of the Berlin Town Council has just approved a scheme for a municipal underground electric railway from the Kreuzberg to the See Strasse. This railway, which would form a connection between the north and the south of the capital, would be 5 miles in length. It is estimated that the expenditure on the construction and equipment of the line, which has naturally to be considered by the Town Council, would amount to £2,425,000.

"EFFLUVIA" FROM THE COMBUSTION OF COAL.

A curious judgement was delivered on appeal by the Justices of the County of London Sessions about a fortnight ago, which has not attracted the attention it deserves, although it appears to place every non-domestic consumer of coal in the awkward position of being liable at any moment to be proclaimed guilty of causing "effluvia" noxious or dangerous to the health of the inhabitants of a district according to the provisions of Sec. 21 of the Public Health Act, of 1891. In order to explain how this judgement was obtained, it is necessary to describe in brief the history of the case. On various occasions during the past two years, occupiers in the neighbourhood of Marlborough Street police station have complained that a nuisance of smoke or odour was to be observed. The matter was investigated, and since the inconvenience was only noticed during the winter months, and when the local wind was apparently in a certain direction, the offenders were believed to be the proprietors of the National Skating Palace, where power is consumed in freezing water by the ordinary carbon dioxide process. The medical officer to the City of Westminster accordingly gave the necessary certificate stating that effluvia noxious or dangerous to the health of the inhabitants were emitted from the shaft of the works. The Mayor, &c., of Westminster, therefore, brought an action against the Acme Investment Co., who own the Skating Palace, which was heard by Mr. Marsham, the police magistrate, sitting at Bow Street last March. During the early stages, and in the preliminary correspondence, nuisance of smoke was alleged, which comes within Sec. 24, not Sec. 21, of the Act; but this complaint was dropped when it was shown that the best smokeless Welsh coal was always employed by the defendants, whose boilers and chimney were admitted to be in an excellent condition. The next point was that the nuisance consisted in the emission of sulphuretted hydrogen; but this was shown by expert evidence not to occur. Finally, however, Mr. Marsham delivered a reserved judgement in which he found the defendants guilty of causing effluvia within the meaning of Sec. 21, and of not having taken the best means available for minimising that nuisance. He, therefore, imposed a fine of £10 and costs.

The case was then taken to Quarter Sessions. The charge of emitting smoke was not pressed, because the action was brought upon the medical certificate. The charge of evolving sulphuretted hydrogen was disproved and dropped by counsel. A new complaint was made of the production of sulphurous acid. This substance was shown to be an inevitable constituent of the combustion products of the best kinds of coal that can be purchased, although the amount present is very trifling. The charge of producing sulphurous acid in appreciable or avoidable quantity was dropped. It was urged that the shaft was too low, and that the boilers were leaky. After expert evidence given by Mr. R. J. Friswell, F.I.C., that these accusations were unfounded, and that it would not really matter if they were true, they were also dropped by counsel. Finally, Mr. Bodkin, on behalf of the plaintiffs, used words to this effect: We claim that in any fire, not being a domestic fire, if its pure smoke (if I may use the term)—not black smoke, but the inevitable products of combustion—causes a nuisance, *i.e.*, discomfort, to any person, then, since a profit is made of such fires, the users thereof are bound to set aside part of the profit and use it to mitigate the nuisance. The Bench apparently accepted this line of argument, and after two days' hearing confirmed the judgement of the magistrate.

Now, since the allegation that the defendants did not do their best to prevent nuisance was abandoned before the Sessions—for it was sworn that the coal was of the best possible quality, that the

amount consumed was under 4 tons per 24 hours, that the plant was in perfect condition, properly managed, and that no odoriferous substance escaped from the defendants' factory—it follows that wherever coal is burnt for any commercial operation, even when no black smoke falling under the purview of Sec. 24 of the Public Health Act is emitted, the products of industrially complete combustion are "effluvia" within the legal sense of the term. On receipt of a complaint signed by the Medical Officer of Health, by two independent qualified medical practitioners, or by 10 inhabitants of the district, in the manner prescribed by Sec. 21 of the said Act, the local authority may proceed under that section with every hope of demonstrating that the "effluvia" are a nuisance dangerous to the health of the neighbourhood. So far as we can see, the same line of procedure may be taken against any non-domestic employer of any carbonaceous fuel, be it gas, liquid, or solid. At present there seems to be no valid defence.

We only deem ourselves at liberty to discuss this matter at its present stage, because we have received personal assurance that the Acme Investment Co. do not intend to go to a higher court. Somebody must appeal, however, for, if we are not mistaken, as long as this judgement stands, every non-domestic fire whose combustion products pass into an inhabited neighbourhood is a legal "nuisance," and its owner is constantly infringing the Public Health Act of 1891 in the manner we have attempted to describe. A mass of highly interesting chemical evidence was given during the two trials of the action regarding the amount of sulphuretted hydrogen and of sulphurous acid liable to be present in the combustion products of coal, and also upon the quantities which must exist in town air to render them offensive to the senses. The most probable cause of the nuisance which was undoubtedly experienced by the householders and others round Marlborough Street, was also mentioned; but all these things tend to divert attention from the main issue, and are not essential. What we desire to point out is this: the proprietors of many central electricity stations have been much harried in the past by accusations of emitting black smoke, but now a far deadlier peril is before them. They are producing Mr. Bodkin's "pure smoke," and they are hardly setting aside parts of their profits to mitigate this nuisance, because they are unable to alter the laws of chemical combustion. As long as the judgement voiced by Mr. McConnell, K.C., on behalf of the County of London Sessions stands, the generation of electricity (except, presumably, from water-power), in populous districts is attended by the production of an "effluvium," and so is the employment of any industrial coal fire or gas stove. As at present interpreted, the law says this effluvium is a nuisance dangerous or prejudicial to the health of the neighbourhood, and the producers of that effluvium must be fined.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

12,725. "Improvements in electro-mechanical apparatus for automatically operating the rail and electrical conductor points on electric tramways and railways from the tram or train." G. D. A. Parr. June 6th.

12,729. "Improvements in electric railways." R. C. Sayer. June 6th. (Complete).

12,737. "An improved electrical motor for variable speeds." J. Bentley. June 6th.

12,741. "Improvements in electric ignition apparatus for internal combustion motors." H. du Cros (Société Anonyme des Anciens Etablissements Panhard and Levassor, France.) June 6th.

12,755. "Improvements in coin-freed apparatus for supplying a current of electricity to persons using it, after the insertion of a predetermined coin and for indicating the strength of the current supplied." J. Carter and S. H. Lehrup. June 6th.

12,801. "Improvements in and relating to dynamo-electric machines." W. B. Sayers. June 6th.

12,821. "An improved adjustable standard for holding an electric glow lamp." A. J. Ware. June 7th.

12,822. "An improved chain for suspending electroliers." A. J. Ware. June 7th.

12,840. "An electrical train describer or indicator." D. Wells. June 7th.

12,844. "An improved Bunsen semi-dry battery." G. Franklin and T. F. Furnival. June 7th.

12,860. "Improvements in incandescent electric lamps and in the manufacture thereof." E. A. Carolan. (The General Electric Co., United States.) June 7th.

12,861. "Improvements in electric contact devices." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 7th.

12,947. "Improvements in or relating to electric current collectors for use in electric traction." S. M. G. Teal. June 8th.

12,949. "Improvements in electric apparatus applicable for exercising and therapeutic purposes." F. Burns. (C. Rohlfs, United States.) June 8th.

12,967. "Improvements in electrical ignition apparatus for explosion engines." A. M. Dean. June 8th.

12,973. "Improvements in electrical measuring instruments." E. I. Everett and K. Edgcumbe. June 8th.

12,975. "An improved life-guard attachment for electric tramcars and the like." C. Henshaw. June 8th.

12,977. "Improvements relating to telephones." J. J. Nye and M. Peck. June 8th. (Complete.)

13,015. "Improvements relating to electric telegraphy." S. G. Brown. June 8th.

13,016. "Improved method and apparatus for obtaining a constant potential current from a variable speed dynamo." F. Loppe and La Compagnie Generale d'Electricite de Creil. (Date applied for under Patents Act, 1901, November 10th, 1903, being date of application in France.) June 8th. (Complete.)

13,040. "An improvement in motor lamps burning paraffin or electricity." S. Russell. June 9th.

13,051. "Improvements in dynamo-electric machines." M. Walker. June 9th.

13,061. "An improved voltmeter." F. O. van de Kasteele. June 9th.

13,072. "Improvements in electric condensers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 9th.

13,073. "Improvements in collector rings for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 9th.

13,083. "Improvements in electro-magnet couplings." H. J. J. Hummel. (J. Pintsch, Germany.) June 9th.

13,084. "Improvements in electric incandescence vapour lamps." J. B. Butler-Burke. June 9th.

13,107. "Improvements in or relating to switch mechanism for use in connection with intercommunication 'telephone instruments or telephone systems.'" The Electric and Ordnance Accessories Co., Ltd., and R. F. Hall. June 10th.

13,158. "Improved plastic composition suitable for the manufacture of buttons, electrical insulating material, or other articles, and process of manufacturing same." A. Geipel. June 10th.

13,169. "Improvements in and relating to electric light fittings." H. Lea. June 10th.

13,216. "Improvements in telephone exchange systems." W. Aitken. June 11th. (Complete.)

13,223. "Improvements in electrolytic meters." S. H. Holden and Chamberlain & Hookham, Ltd. June 11th.

13,253. "Improvements in the manufacture of filaments for incandescent electric lamps." J. R. Crawford. June 11th.

13,264. "Improvements in continuous current electric motors and generators." L. Torda. June 11th.

13,274. "Improvements in means for controlling the trolleys of electrically propelled vehicles." C. W. G. Little. July 11th.

13,276. "Improvements in protective devices for electric generating and distribution systems and apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 11th.

13,277. "Improvements in coil-winding apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 11th.

13,278. "Improvements in electric transformers, reactances, and the like." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 11th.

13,283. "Improvements in and relating to means for supplying or cutting off current in connection with single or polyphase alternating current motors." The Union Elektricitats-Gesellschaft. (Date applied for under Patents Act, 1901, June 30th, 1903, being date of application in Germany.) June 11th. (Complete.)

13,284. "Improvements in and relating to means for starting and controlling alternating current motors." The Union Elektricitats-Gesellschaft. (Date applied for under Patents Act, 1901, June 30th 1903, being date of application in Germany.) June 11th. (Complete.)

PUBLISHED SPECIFICATIONS.

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1903.

Electric Motors. R. Klemm. 14,888. July 4th.

Electrolytic Production of Zinc. K. Kaiser. 15,420. July 11th.

Electric Cut-outs. The Aktiengesellschaft Brown, Boveri & Cie. (Date claimed under Patents Act, 1901, November 14th, 1902, being date of application in Switzerland.) 15,500. July 13th.

Prevention of Electric Shocks in Systems of Electrical Distribution. H. H. Lake. 16,190. July 22nd.

Electrical Resistances. T. E. Weaver. 16,232. July 23rd.

Electric Arc Lamps. H. Beck. 16,294. July 23rd.

Electric Railway and Vehicles for Transporting Letters and other Light Loads at High Speeds. D. Mounier. 16,583. July 28th.

Induction Transformer for Wireless Telegraphy Stations. E. Ducretet. 17,084. August 5th.

Electrical Fire Alarm. J. P. Robertson. 16,965. August 4th.

Coin-freed Electricity Meters. F. J. Beaumont. 17,721. August 15th.

Selective Systems for Electrical Communication. S. A. Reed. 18,841. September 1st.

Controlling Apparatus for Electric Motors. B. G. Lamme. (Date claimed under Patents Act, 1901, September 29th, 1902, being date of application in United States.) 19,887. September 15th.

Electric Cable Terminal. T. Ballard and W. Howard. 20,012. September 17th.

Arm-supporter for Telephones and the like. H. Ehret. 20,547. September 24th.

Process and Apparatus for the Electrolysis of Chlorides of the Alkalies. C. Kellner. 21,859. September 29th.

Insulated Electric Conductors and Method of Producing the same. J. A. Heany. 20,921. September 29th.

Electric Current Regulators. S. E. Page. 20,916. September 29th.

Alternate Current Motors. Compagnie pour la Fabrication des Compteurs et Material d'Usines a Gas. 21,208. October 2nd.

Electric Railways. W. M. Eader. 21,516. October 2nd.

Electric Lamps. J. B. B. Burke. 21,806. October 3rd.

Electric Arc Lamps. F. Jeannot and F. de Z. Bermudez. (Date claimed under Patents Act, 1901, September 12th, 1902, being date of application in France.) 21,466. October 6th.

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Electrical Alarm Clock. H. Peters. 21,687. October 8th.

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Regulating Dynamos, Motors and like Electric Machines. A. R. Muller. 22,673. October 20th.

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Electrically Heated Handles. R. A. Fliess. 23,161. October 26th.

Electrically Illuminated Signs. J. H. Goehst. 23,224. October 27th.

Telephone Relays or Repeaters. G. E. Sundquist and A. H. Wahl. 23,285. October 27th.

Secondary Batteries. G. Rosset. 23,482. October 29th. (Date claimed under Patents Act, 1901, November 24th, 1902, being date of application in France.)

Wireless Signalling Systems. H. Shoemaker. 23,574. October 30th.

1936